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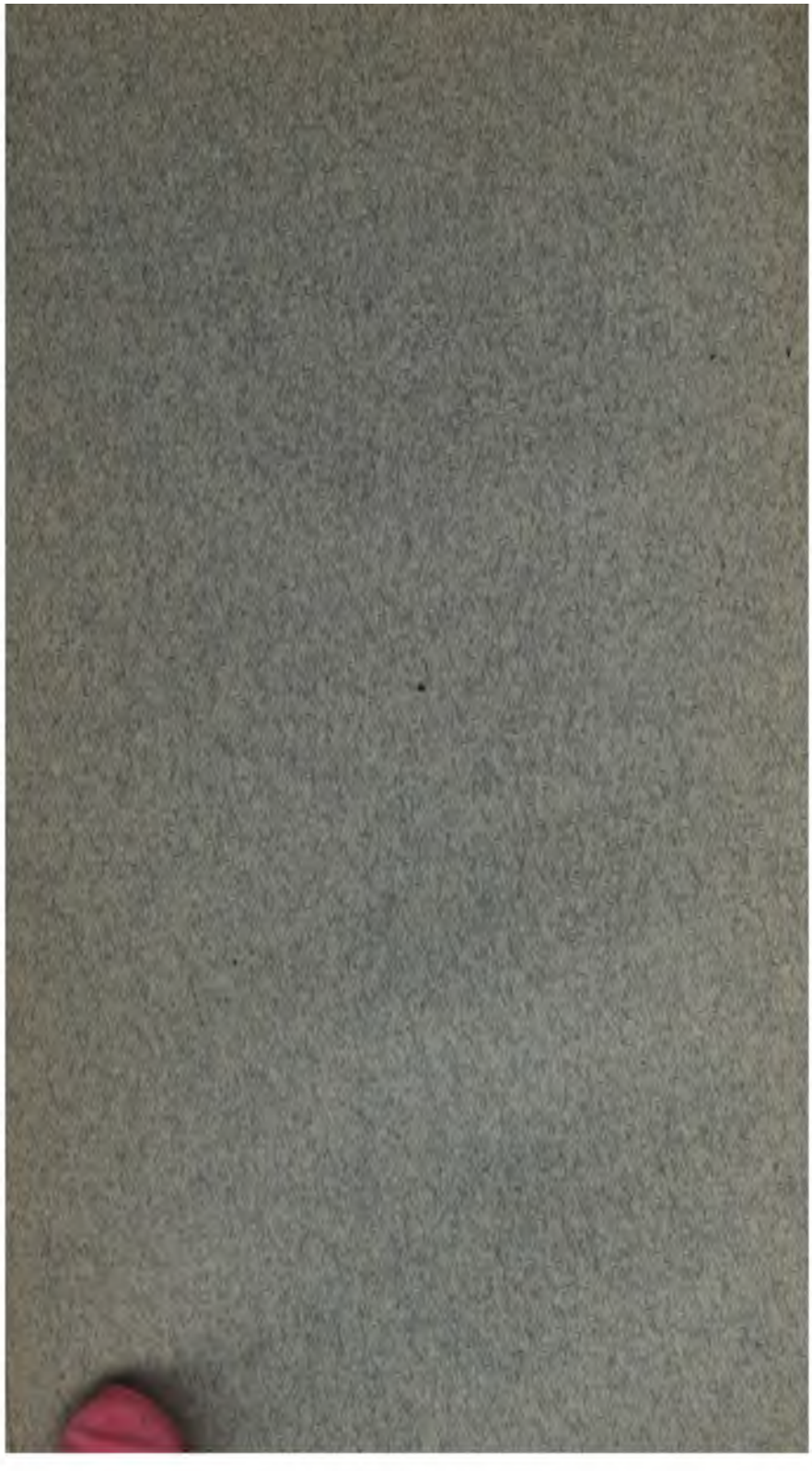

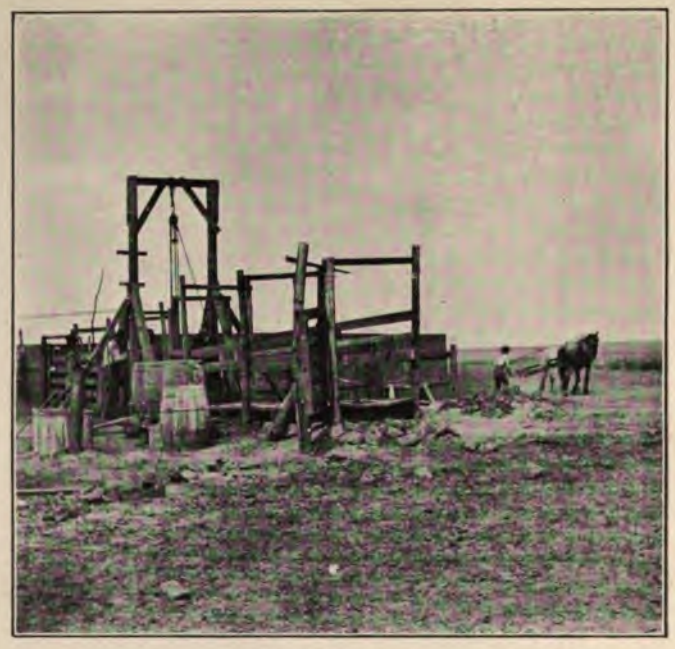

FIG. 1.—LANGEDAHL. RAISING CAGE LOADED WITH TWO YEARLINGS.

FIG. 2.—LANGEDAHL. STEER JUST LEAVING CAGE.

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U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF ANIMAL INDUSTRY—BULLETIN NO. 40.

D. E. SALMON, D. V. M., Chief of Bureau.

DESCRIPTION AND TREATMENT

OF

CABIES IN CATTLE.

BY

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WASHINGTON:

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1902.

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with the result that scabies, or mange, in cattle may in some cases prove fatal; especially are fatal terminations liable to occur in the latter part of a severe winter among immature and growing animals, or those of adult and full age when in an unthrifty condition at the time of becoming infected. There have been noticed variations in the progress of the disease depending upon extreme seasons—aggravation in winter alternating with improvement in summer.

The mite which causes cattle itch, or mange, is closely related to the mite which causes sheep scab—both belonging to the same genus and species, but are different varieties. The sheep-scab mite will not attack cattle, nor will the cattle mite attack sheep or other animals. The itch mites are found to be very numerous upon affected cattle, and a very small quantity of débris from an actively infested area of the skin will often reveal a surprisingly large number of the parasites. These mites may be removed from an animal and retain their vitality for a long time. Specimens have been collected and kept in small glass bottles in the laboratory at the ordinary temperature of the room during the winter months varying from 45° F. during the night to 80° F. during the day, which would live and remain active from eight to eleven days. Exposure to bright sunlight, however, would kill most of the mites in a few hours.

Scabies does not appear to affect cattle while they are doing well on grass, nor attack those in good condition over three years old. The animals which suffer most are calves, yearlings, and two-year-olds, and those in poor condition. The first symptom of the disease is usually an intense itching of the skin about the neck or shoulders, and it extends more or less rapidly, depending largely upon the health and vigor of the animal, along the back and sides and down the outside of the legs, but does not usually affect the inside of the legs or the skin of the abdomen.

The other variety of this parasite which produces mange in cattle is the *Chorioptes symbiotes* var. *bovis*. This is known as symbiotic mange, or tail mange. It remains generally localized upon the depressions on the back part of the croup and at the base of the tail. It may, however, extend over the whole surface of the body if the treatment of the disease and care of the affected animals are neglected. These cases, however, are rare. Foot mange is also exceptional in cattle. Symbiotic mange has almost no spreading tendency, and its contagiousness is hardly noticeable. It yields readily to treatment and any remedy that will destroy the activity of the parasite producing the Psoroptic, or common, form of mange will readily kill that causing the symbiotic, or tail, mange. It is possible for the different morbid conditions produced by these two varieties of parasites (*Psoroptes communis* and *Chorioptes symbiotes*) to coexist.

FORM AND LIFE HISTORY.

The Psoroptes live upon the surface of the skin, adhere to it, and suck the blood and lymph of the skin by means of their mouth organs, producing a more or less intense inflammation through the numerous stings which they inflict. This species is characterized by its relatively greater size, its dimensions being 0.5 to 0.8 millimeter. Its general form is rounded or ovoid. It can be seen with the naked eye upon dark surfaces, and is very easily seen with the help of a magnifying glass. The head is elongated and pointed. The mandibles are long, straight, and stinging. The legs are very long. The sucking cups, tulip or trumpet shaped, are carried by articulated pedicles. In the male they are seen on the four pairs of legs; in the female, upon the first, second, and fourth pairs only. The Psoroptes in their immature form have three pairs of legs, while in the adult state they possess four. The latter with five joints are fitted with suction cups covered with fine hair and armed with claws or hooks. The head, thorax, and abdomen are not separated. The organs of mastication are represented by mandibles. The skin surface is covered with scales, hair, spikes, or silky hair, etc.

Females, which are larger than males, lay from 20 to 24 eggs; at the end of 4 to 7 days the larvæ come out, and after having undergone 3 or 4 metamorphoses, arrive at the stage of reproduction from the fourteenth to seventeenth day. If exposed to damp air, or placed upon wet manure, the mange parasites continue to live from 6 to 8 weeks. Upon damp ground the eggs remain alive from 2 to 4 weeks. In a dry place they lose their vitality after 4 to 6 days. Moderate heat is favorable to their vitality and to the hatching of the parasites.

In warm places under cover, and during the summer, their movements are more active and they multiply more rapidly than under the opposite condition. It has been estimated that one female alone may produce 1,500,000 individuals in 90 days.

Each animal species has its acari, or specific mange parasites; consequently, the expression "mange" must necessarily be incomplete unless the variety of the parasite is indicated. Thus of the Psoroptic acari, we have *Psoroptes communis equi*, which produces Psoroptic mange in the horse, *Psoroptes communis bovis* in the ox, and *Psoroptes communis ovis* in the sheep.

In each of these animals we also have the symbiotic mange, and in each the variety would be designated as in the case of the Psoroptic form; but in neither variety is the contagion transmitted from one species of animal to the other. The symbiotes live especially upon the surface of the skin of the extremities, and exist in epidermic scabs. They are from 0.3 to 0.5 of a millimeter in diameter. Their outlines are visible to the naked eye or with the magnifying glass.

The head is short, and wider than long. The body is slightly ovoid and notched upon the periphery. The legs are long and the sucking cups are shaped like a Roman shield, and are distributed in both the male and female, as in the case of the same organs on the legs of the Psoroptes.

Sarcoptic mange is a more serious disease than either of those already described, but is not common to cattle. It would not, therefore, seem important to refer to this form of mange parasite and occupy space in this bulletin except by a reference to the serious disease which is produced by the Sarcoptes through certain characteristics natural to them. We find Sarcoptic mange in the following domesticated animals—horse, sheep, goat, dog, cat, and pig.

The Sarcoptes dig subepidermic galleries and live on the plasma cells of the malpighian layer. They multiply in these galleries and occasion a very intense dermatitis, or inflammation of the skin. Because of the depth to which the Sarcoptes burrow, Sarcoptic mange is exceedingly hard to eradicate. It would, therefore, seem fortunate that this form of the disease is not common to cattle. It is rebellious to all medication, and very frequently recurrences of the disease produced by the Sarcoptes are seen in other species of animals after treatment which has been prolonged for months.

Concerning the transmissibility of the different manges to animals and man, we find that all Sarcoptes may live for an indefinite period upon man's skin, but the Psoroptes and Symbiotes die very rapidly and occasion but slight irritations. The horse may contract Sarcoptic mange of the sheep, pig, dog, and cat. The ox takes the Sarcoptes of the horse, sheep, goat, and cat. The sheep contracts Sarcoptic mange of the goat. The dog takes the Sarcoptes of man, pig, cat, sheep, and goat. The pig contracts Sarcoptic mange of the goat. From this it will be seen that Sarcoptic mange, unlike the Psoroptic and Symbiotic manges, is transmissible from one species of animal to another.

Mange is never developed except by contagion. The period of incubation—that is, the interval that lapses between the moment when the acari are deposited upon the surface of the body and the appearance of the disease on the skin—varies according to the number of parasites transmitted. When in small numbers, the first manifestations of mange are sometimes only seen at the end of 4 to 6 weeks, while at other times the disease may be clearly apparent at the end of 15 days. Contamination takes place either by direct contact—that is, immediate, as on pasture, at the stable, etc.—or by intermediary agents.

Place the unslaked lime in a mortar box or some suitable vessel and add enough water to slake the lime and form a lime paste or lime putty. Sift into this lime paste the flowers of sulphur and stir the mixture well. Be sure to weigh both the lime and sulphur, and do not trust to measure them in a bucket or guess at the weight. Place the sulphur and lime paste in a kettle or boiler with about 25 or 30 gallons of boiling water, and boil the mixture for two hours at least, stirring the liquid and sediment. The boiling should be continued until the sulphur disappears, or almost disappears, from the surface. The solution is then of a chocolate, or liver, color. The longer the solution boils the more the sulphur is dissolved, and the less caustic the ooze becomes. Most writers advise boiling from thirty to forty minutes, but a much better ooze is obtained by boiling from two to three hours, adding water when necessary. Pour the mixture and sediment into a large tub or barrel, placed near the dipping vat, and provided with a bunghole about 4 inches from the bottom, and allow it ample time (from two to three hours or more if necessary) to settle. The use of some kind of a settling tank provided with a bunghole is an absolute necessity, unless the boiler is so arranged that it may be used for both boiling and settling. An ordinary kerosene oil barrel will answer very well as a small settling tank. To insert a spigot about 3 to 4 inches from the bottom is an easy matter. Draining off the liquid through a spigot has the great advantage over dipping it out in that less commotion occurs in the liquid, which therefore remains freer from sediment. When fully settled, draw off the clear liquid into the dipping vat and add enough warm water to make 100 gallons. The sediment in the barrel may then be mixed with water and used as a disinfectant, but under no circumstances should it be used for dipping purposes. A double precaution against allowing the sediment to enter the vat is to strain the liquid through ordinary bagging as it is drawn from the barrel or settling tank.

The above directions are for the quantity of dip given in the preceding formula. Any multiple of the constituents may be used, depending upon the capacity of the boiler, vessels, and tank to be filled, but, let it be repeated, that there should be no guessing about the proportions; that the directions for the preparation of the dip as here given should be closely followed, care being taken that boiling be continued for the full time recommended, and that the sediment is not used for dipping purposes.

In order to attain success in the treatment of mange, care and thoroughness of method must be observed. Animals that have been exposed should be dipped as well as those that show distinct evidences of the disease. After the lapse of a few weeks following the first dipping, the animals should be subjected to a second dipping, in order that parasites which may have survived the first treatment, or that

may have gotten on the animals from corrals, sheds, buildings, or elsewhere, may be destroyed. Several thousand cattle were carefully examined by our inspector forty days after being put through the dip for the second time and he failed to find evidence of scabies on any of them. These animals commenced to improve soon after being subjected to the first dip, as the dip killed lice as well as the scab mites, and owners of cattle adjacent to the dipping plants have declared their intention to dip in future years to kill lice, even if scabies does not exist. The dip liquid in the tanks during the whole dipping process should be kept at a temperature of from 102° to 110° F. Each animal should be kept two minutes in the dip, and be put completely under twice during that time. All bad cases should be hand-rubbed and kept in the dip four minutes.

Pregnant cows have been treated, as well as cattle of all ages, from calves to full-grown steers, with the loss of but one animal in one of the swimming tanks. This was a steer which for some reason seemed to be unable to swim and was drowned. It would appear that the dipping of cows has no appreciable effect upon abortions, as a comparison with previous years showed that the dipping had not increased the average number of abortions regularly occurring among these herds before dips were used.

DIPPING PLANTS.

Of the various dipping plants in use, there are but two kinds that need description—the small dipping plant, which is inexpensive and suitable for use by a community of farmers, and the larger dipping plant with swimming tank, such as would be needed if large numbers of range cattle are to be treated. A suitable plant for a community of farmers has been built for $150, while a swimming tank will cost $350.

Such a plant as that in operation 18 miles north of Steele, N. Dak., known as the Langedahl, would seem to be an admirable example of the smaller kind. This plant, with the exception of the tank, was built by farmers. A thrashing engine was used for heating purposes by connecting a 1¼-inch pipe to the whistle intake, the whistle being removed, and the pipe joined to the union. The plant has a capacity of 200 head per day. Its cost, without engine or labor, excepting the labor to build the tank or vat, was $150. One person can easily lower the cage when loaded by taking a hitch around a post, and it may be raised, as shown in illustrations, either with engine or horses. (See frontispiece.)

Following are the drawings and list of materials for the smaller plant, the tank of which may be filled with dip made as per preceding formula for about $7.50. Drawings and list of materials were furnished by Dr. Robert H. Treacy.

LIST OF MATERIALS.

Entrance pen and chute.

65 plank 2 inches x 6 inches x 16 feet.
28 posts.
18 braces 4 4 4 .

Tank, or vat.

800 feet good 2-inch plank.
400 running feet tongue strip.
10 pieces 4 inches x 4 inches x 16 feet.
2 pieces 2 6 16 .
10 pounds lead.

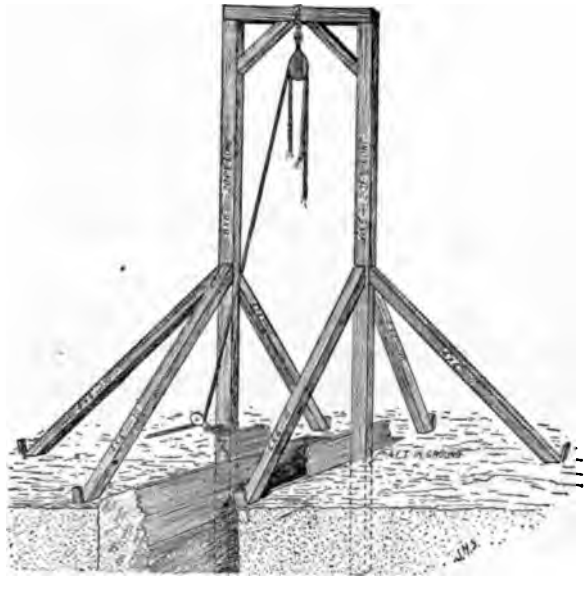

FIG. 1.—Derrick. Sixteen ft. high above ground. Derrick posts 4 ft. in ground, 6 by 6 by 20 ft. long. Braces 4 by 4 by 10 ft. long; 2 double-leaf 6-in. blocks at top of derrick, and 1-leaf 5-in. pulley at bottom of derrick; 100 ft. of 1-in. rope.

Cage.

8 pieces 4 inches x 4 inches x 16 feet.
8 pieces 2 4 16 .
12 pieces 2 10 16 .
10 pieces 1 10 16 .
4 half-inch iron rods, with ring in each end, 5½ feet long.
2 half-inch iron rods, with ring in each end, 4 feet long.
3 pair of heavy hinges.

Derrick.

2 pieces 6 inches x 6 inches x 20 feet.
1 piece 6 6 10 .
6 pieces 4 4 12 .

Drip chute.

10 pieces 2 inches x 6 inches x 14 feet.
4 pieces 2 " 12 " 14 "
4 pieces 4 " 4 " 16 "
1 pair heavy hinges.
1 gallon tar.

Holding pen.

32 cedar or oak posts.
200 pounds wire.
5 pounds staples.

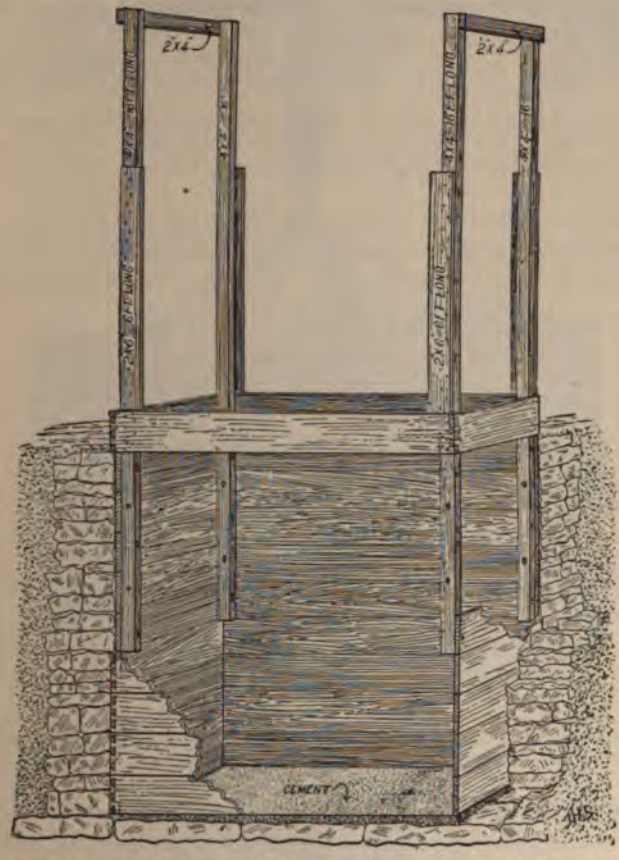

FIG. 2.—Vat. Tank 10 ft. deep, 4 ft. wide, 9 ft. in ground. Should contain from 5½ to 6 ft. of dip. Standards 4 by 4 by 16 ft. long, bolted to tank inside, to extend 6 ft. inside of tank, to act as guides to cage; 2 by 6 in. plank 6 ft. long nailed to outside of standards; 2 by 4 or 2 by 6 in. braces across top of standards. The tank should be built of 2-in. plank and joined with a tongue, the ends of the tank mortised in, the joints coated with lead. The braces are 4 by 4. The tank, being placed in the ground and packed solid, does not require much bracing. The tank should be laid in cement bottom, with stone and mortar about sides.

Hardware and incidentals.

100 pounds 20-penny spikes.
20 pounds 40-penny spikes.
2 6-inch double-leaf blocks.
1 5-inch single-leaf block.
100 feet 1-inch rope.
25 feet 1½-inch iron pipe.
1 galvanized-iron heating tank (5 barrels capacity).
4 oil barrels.

A plant of this capacity will answer very well in a community where various owners have bunches of cattle ranging from 80 to 100 head or

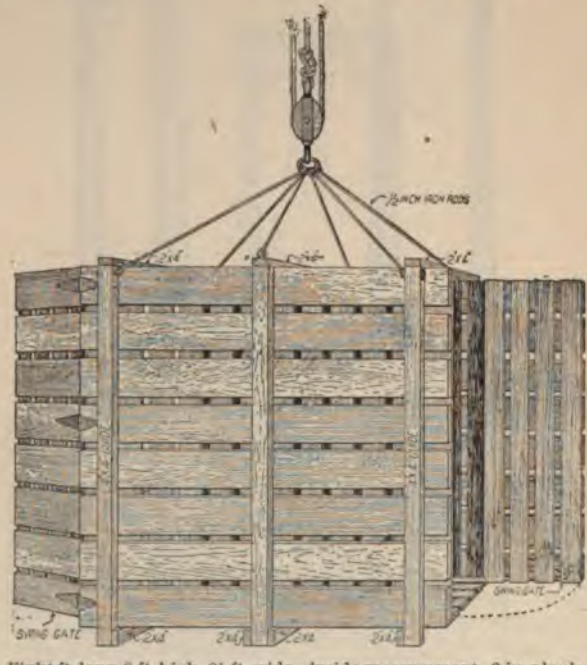

FIG. 3.—Cage. Eight ft. long, 8 ft. high, 2¼ ft. wide—inside measurement; 2-in. plank used for outside boarded up and down inside with 1-in. boards to keep animals from climbing up sides. Plank 2 in. apart. Inside boards 2 in. apart, and 1-in. cracks in floor to allow free escape of dip fluid.

less. Among its chief advantages over the swimming tank are cheapness in construction, because of its size, and proportionately smaller expense in operating; the dip can be kept at the required temperature with facility, because of its lesser volume, and the submerging of the animals, as well as the length of time it is desired to keep them in the dip, can be more easily regulated.

In communities where mange does not exist and where numbers of small herds are infested with lice, a plant of this character might be constructed and used with profit to the cattlemen. Many of the cattle that were dipped during the past year because of having been exposed

to mange, or scabies, by being herded with those affected, showed much improvement in condition soon after dipping, as they were

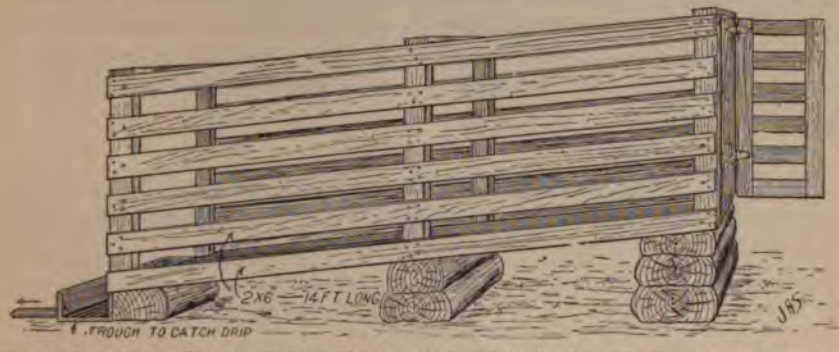

FIG. 4.—Drip chute. Fourteen ft. long; 2 by 6 in. plank; 5 ft. high. Set with 18-in. slope from front to rear. Trough at rear to catch drip, from which a pipe may be run to connect with tank to carry drip from drip chute back into tank. Floor of drip chute should be tight to prevent waste.

infested with lice to a considerable extent, although showing no distinct evidence of being affected with mange. It was observed that the lousy and mangy cattle stopped rubbing or digging after the first dip,

FIG. 5.—Sand glass. For timing the animals in the dip. Is made of two ordinary ketchup bottles connected by a hollow wooden cork, placed in a box, and the box hung on a pin through the center to revolve, as shown in the illustration.

and improved rapidly after being relieved of the torture that is inflicted by both of these troublesome parasites—scab mites and lice.

SPECIFICATIONS FOR LARGE DIPPING PLANT WITH SWIMMING TANK.

The following plans and specifications are for the construction of such a dipping plant as that of the Rice Lake Cattle Company, which is located 12 miles north of Sterling, N. Dak., and are in accordance with the drawings made for that company after the following specifications:

SPECIFICATIONS.

Specifications of labor and materials required in the construction of a cattle dipping plant to be built at — — ——— for ——— ———, in accordance with drawings made for the same by A. Van Horn, of Bismarck, N. Dak.

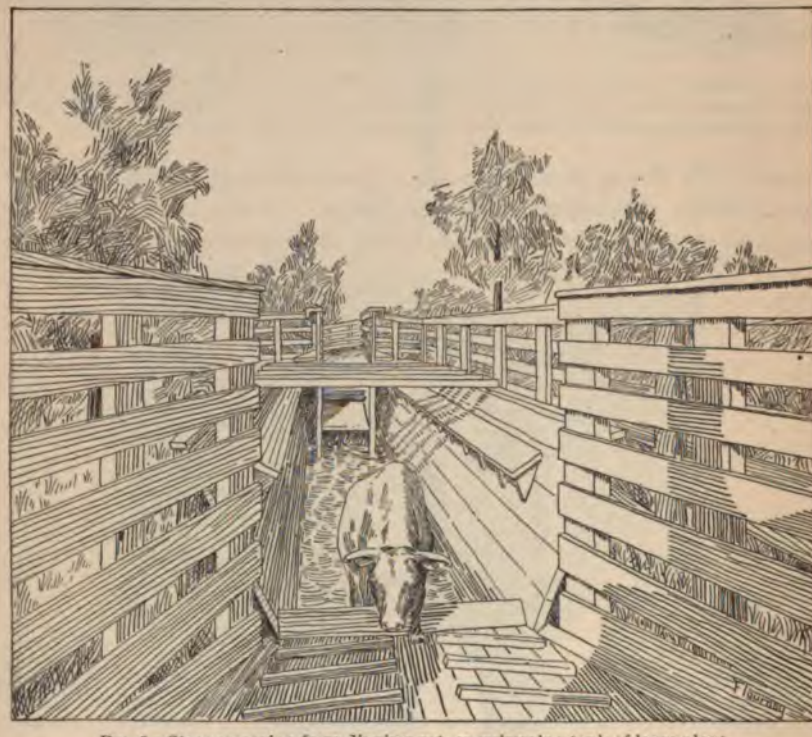

FIG. 6.—Steer emerging from dipping vat, or swimming tank of large plant.

Excavations.—Excavate for the vat, as shown by the drawings, to the proper depth; level the bottom of the pit for the sills of the vat. After the vat is completed and the outside has been coated with coal tar, fill in around the vat, using the surplus earth to bank up and grade the sides of the vat above the natural grade, sloping the banks from the vat. Dig all holes required for the gate and fence posts.

Carpenter work.—All work must be done in a skillful and workmanlike manner; the framework of the vat to be bolted and spiked together; the plank of sides, ends, and bottom of the vat and dripping floor to have edges beveled for the calking as per detail, well driven together and well spiked with 20d. wire nails, using 40d. nails on the 3-inch plank. Calk all seams with oakum, well driven in with a calking iron and pitched. The exit, or inclined end, of the vat to have 3-inch bottom plank; all

other plank of the vat and dripping floor to be 2 inches thick. Top of vat to be tied with 4 x 4 inch ties across top, framed and bolted to uprights as shown. Put 2 x 12 inch splash boards on sides at top of vat, nailed to under side of tie timbers and braced. The exit end of vat and dripping floor to be cleated with 1½ x 3 inch strips, well nailed to floor and bottom. Construct the trap at entrance—30 x 84 inches—of

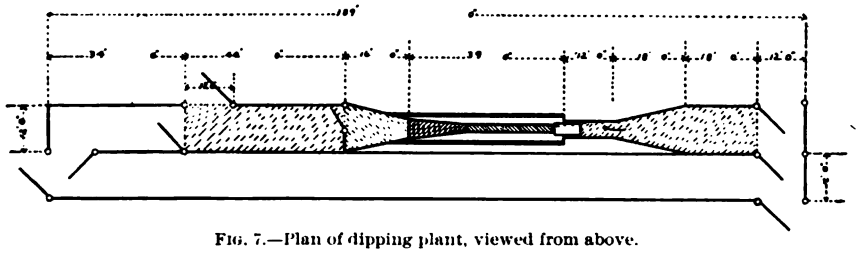

FIG. 7.—Plan of dipping plant, viewed from above.

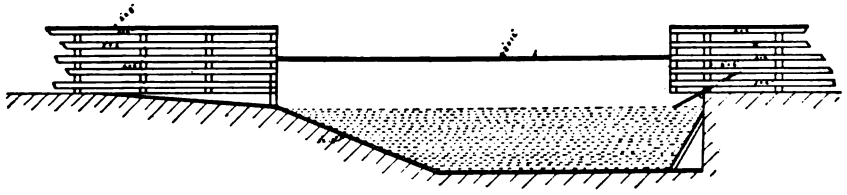

FIG. 8.—Vertical section of dipping vat, with older-style automatic trap on pivot. It will be seen that the incline at the bottom of the trap end of the vat is in a perpendicular line with the free end of the trap; where the spring trap is used, the length of the incline should be increased in order that at the bottom of the vat it may still be in line perpendicularly with the end of the trap when set; otherwise cattle are liable to get back under the trap, causing trouble.

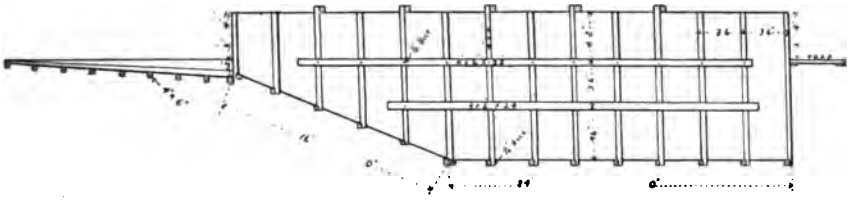

FIG. 9.—Side view of dipping vat, showing inclined egress and dripping floor.

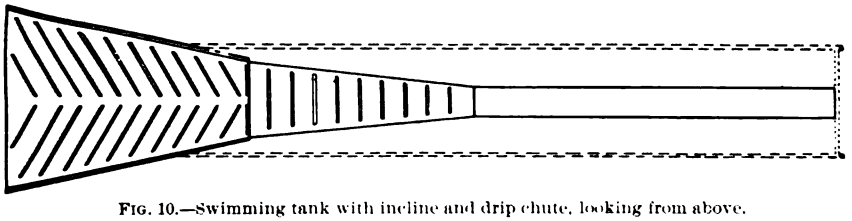

FIG. 10.—Swimming tank with incline and drip chute, looking from above.

2-inch plank, with 2 x 10 inch battens bolted together, top to be covered with 14-gauge sheet steel. Trap to swing on a 2-inch wrought-iron pipe or 2-inch steel bar seated in the end of vat, with ½ x 4 x 12 inch iron sockets bolted to vat. Secure the trap to the axle with iron straps bolted to under side of the center battens. End of vat to have false back as shown.

Gates and fence.—Construct and erect the gates and fence as per drawings. The gate post to be set 4 feet in the ground and the fence posts 3 feet 6 inches. Set all posts plumb and to a line; well and thoroughly tamp the earth around the posts. The bottom of all posts to be coated with coal tar before being set. Gate posts to be

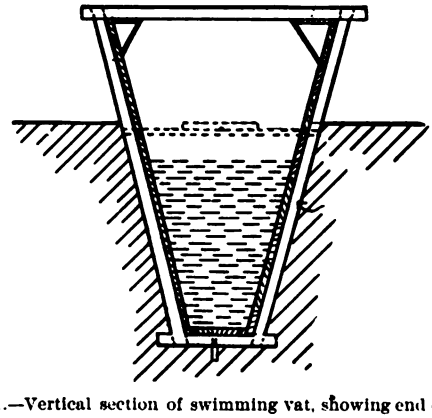

FIG. 11.—Vertical section of swimming vat, showing end of trap.

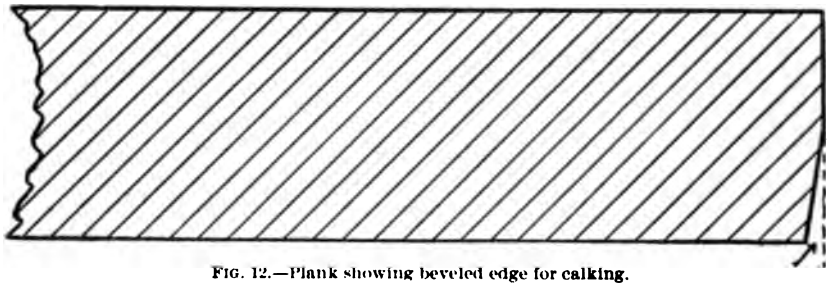

FIG. 12.—Plank showing beveled edge for calking.

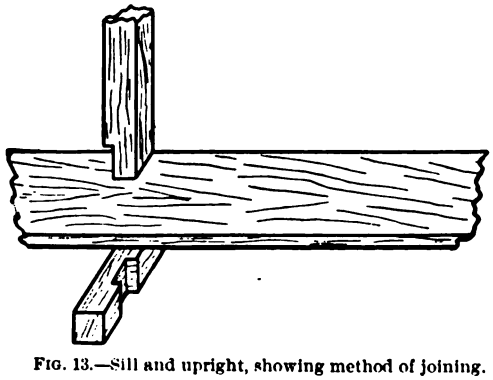

FIG. 13.—Sill and upright, showing method of joining.

8 x 8 inches, with 6 x 8 inch tie framed and driftbolted to the posts. Fence posts to be 6 x 6 inches. The gates to be bolted and spiked together and braced as shown. To be hung with ½ x 3 x 36 inch strap eye-and-bolt hinges. Bolt to run through posts and hinges bolted to gates. Gates to have ½ x 3 x 16 inch iron hasp bolted to gates and a suitable bolt staple, with iron pin and chain for locking.

Fence.—The fences to be five-railed, with cap, ribbon fence. Rails, or ribbons, to be of 2 x 6 inches, with 2 x 8 inch cap, spiked at each bearing with two 40d. wire nails. Posts to be set 8 feet on centers, or nearer where distance may require.

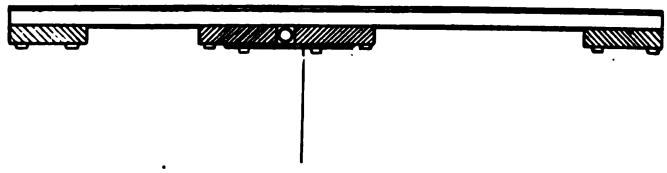

FIG. 14.—Vertical section of an older style of automatic trap, showing 2-in. iron pipe upon which trap is pivoted.

Lumber.—All lumber to be to No. 1 pine or fir dimension, free from shakes, bark, large pitch pockets, unsound knots, or other imperfections that materially impair its strength, durability, and use for which it is intended.

Drainage.—The vat to have a 2-inch waste pipe fitted in the bottom with gate valve and elbow, and 20 feet of pipe to run horizontally under ground, with a fall of 2 feet on 16 feet. At this point the owner will take up the drainage without cost to the contractor, and continue the same to a suitable point either by pipe or open ditch.

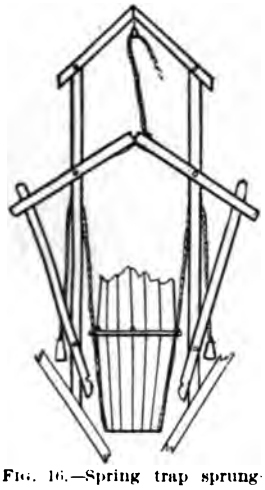

FIG. 16.—Spring trap sprung. This trap is hung on an iron rod or on a 2-in. iron pipe; weights are attached at the free end to pull it back in place; it then sets automatically.

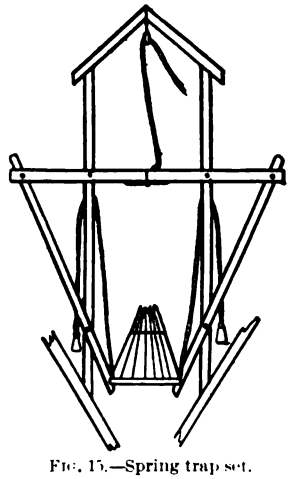

FIG. 15.—Spring trap set.

Dimensions of vat.—Perpendicular depth of vat to be 10 feet; width at top, 7 feet; width at bottom, 2 feet; length of level bottom, 24 feet; horizontal length of sloping bottom, 15 feet; width of dripping floor at upper end, 12 feet; at lower end, 5 feet.

Floor of pens.—Should the owner decide to floor the catch pen and holding pen No. 1, the floor will be of 2-inch plank nailed to 4 x 4 inch joist or sleepers let into the ground and leveled. The sleeper to receive one coat of coal tar before being laid.

LUMBER BILL.

Vat and dripping floor.

Plank for sides, ends	1,080 feet = 30 pcs.	2″	x 12″	x 18′	No. 1 pine or fir.	
False back and bottom	576	24	2	12	12	"
	64	2	2	12	16	"
	96	2	2	12	24	"
		or 3			16	"
	240	5	3	12	16	"
	72	2	3	12	12	"

Sills, uprights, and ties	24 feet =	1 pc.	4″	x 4″	x 18′	No. 1 pine or fir.
	37	2 pcs.	4	4	14	"
	64	3	4	4	16	"
	32	2	4	4	12	"
	27	2	4	4	10	"
	64	2	4	6	16	"
	336	21	4	4	12	"
	96	4	4	4	18	"
	21	1	4	4	16	"
	19	1	4	4	14	"
Splash boards	160	4	2	12	20	"
Cleats	54	9	1½	3	16	"
Trap	23	1	2	10	14	"
	30	1	2	10	18	"
Total	3,115 feet.					

Gates.

Posts	896 feet =	14 pcs.	8″	x 8″	x 12′	No. 1 pine or fir.
Tie beams	448	8	6	8	14	"
Ribbons	480	40	2	6	12	"
Braces	144	8	2	6	18	"
Battens or rails	96	6	2	6	12	"
	128	4	4	6	16	"
Total	2,192 feet.					

Fence.

Posts	2,010 feet =	67 pcs.	6″	x 6″	x 10′	No. 1 pine or fir.
Ribbons	240	20	2	6	12	"
	140	10	2	6	14	"
	1,760	110	2	6	16	"
	450	25	2	6	18	"
Caps	64	4	2	8	12	"
	32	2	2	8	14	"
	469	22	2	8	16	"
	120	6	2	8	18	"
Total	5,285 feet.					

NOTE.—Oak or cedar posts are to be preferred. If round cedar posts are used, substitute 10-inch round posts for the 8 x 8 inch and 8-inch round posts for the 6 x 6 inch posts as above.

For catch pen.

There should be a plank floor in the catch and holding pen No. 1, but if only a limited number of cattle are to be dipped this may be omitted.

If it is decided to floor these pens the following material should be added to the foregoing lumber bill:

For holding pen No. 1	240 feet = 15 pcs. 4″ x 4″ x 12′ No. 1 pine or fir.
	850 " 2″ pine or fir plank, 12″ x 18′.
	240 " = 15 pcs. 4″ x 4″ x 12′, No. 1 pine or fir.
	960 " 2″ plank 16′.
Total	2,290 feet of additional lumber.

Cottonwood lumber may be used where the market price of same would make it practical.

SCHEDULE OF HARDWARE, ETC.

Vat and dripping floor.

42 carriage bolts, ½″ x 6″, with washers.
40 " ½ 8 "
18 " ½ 4 "
40 lbs. 20d. common wire steel nails.
10 " 30 " "
15 " 50 " "
1 sheet No. 14 sheet steel, 30″ x 84″, with 1 gross 1″ No. 10 screws.
20 lbs. oakum.
40 " pitch.
10 gals. coal tar.
5 feet 2″ pipe or steel bar, for trap.
21 " 2″ wrought-iron pipe, with couplings.
1 elbow, 2″.
1 flange for securing pipe to bottom of tank, 2″.
1 gate valve, 2″.

Gate and fence.

8 pairs eye-and-bolt hinges, heavy, ½″ x 3″ x 36″.
8 hasps, ½″ x 16″ x 3″, with bolt staple, for 8″ posts.
48 bolts, ½″ x 3″.
20 " ½ 4½
68 " ½ 6
160 " ½ 4
32 driftbolts, ½″ x 12″.
20 lbs. 30d. common wire nails.
65 " 40 " " "
16 gal. coal tar.

NOTE.—If catch and holding pen No. 1 is to be floored, add to the above 30 lbs. of 30d. wire nails and 5 gallons coal tar.

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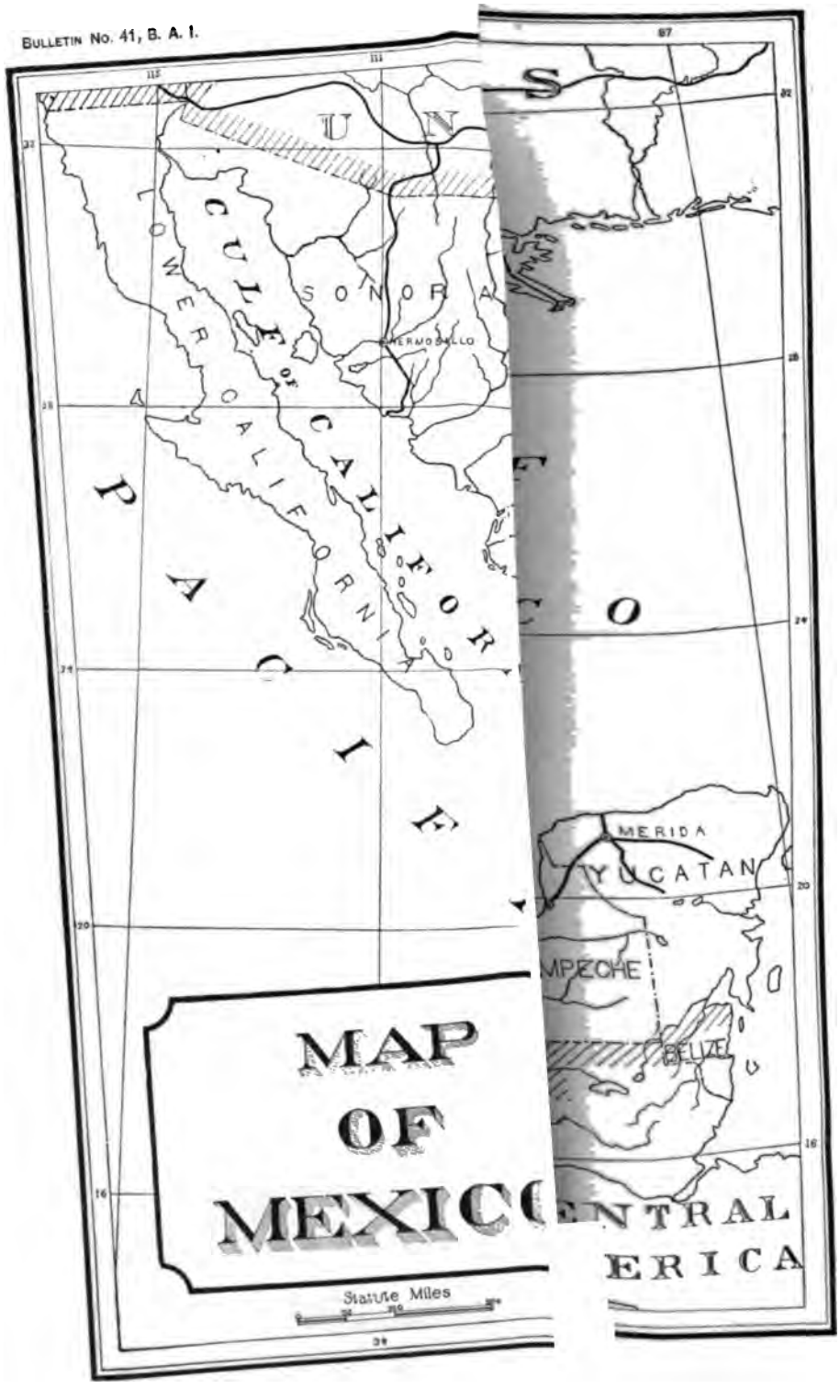
MAP
OF
MEXICO
Statute Miles
SONORA
HERMOSILLO
LOWER CALIFORNIA
GULF OF CALIFORNIA
PACIFIC
MERIDA
YUCATAN
CAMPECHE
BELIZE
CENTRAL
AMERICA

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY—BULLETIN No. 41.
D. E. SALMON, D. V. M., Chief of Bureau.

MEXICO AS A MARKET

FOR

PUREBRED BEEF CATTLE

FROM THE

UNITED STATES.

BY

D. E. SALMON, D. V. M.,
Chief of Bureau of Animal Industry.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1902.

LETTER OF TRANSMITTAL

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
Washington, D. C., January 31, 1902.

SIR: I have the honor to transmit herewith some data relative to the importation of cattle into the Republic of Mexico, which will probably be helpful to those breeders of purebred cattle in the United States who may be inclined to avail themselves of the advantages which are now offered in that country. I recommend the publication of this matter as Bulletin No. 41 of the Bureau of Animal Industry.

Respectfully,

D. E. SALMON,
Chief of Bureau.

Hon. JAMES WILSON,
Secretary of Agriculture.

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Map of Mexico ..... Frontispiece

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MEXICO AS A MARKET FOR PUREBRED BEEF CATTLE.

PRELIMINARY STATEMENT.

The purpose of publishing the information contained in this bulletin is to assist those who raise purebred cattle to find a market for their surplus animals. A careful perusal of the letters from the United States consular officers in Mexico shows very clearly that there is a great demand in Mexico for bulls of our beef breeds for improving the size and quality of the small Mexican cattle. There are already many of them being used for this purpose in that country. The letters also point out some of the principal drawbacks which exporters of cattle to that country encounter, but at the same time the opportunities afforded are fully set forth.

The largest cattle ranches of Mexico are in the northern States—those bordering the United States, such as Sonora, Chihuahua, and Coahuila—but cattle raising is an industry of no mean proportions in many other of the States of the Republic. These ranches are there called haciendas, and many of them contain many hundreds of square miles. It is not uncommon to find upon them as many as 20,000 head of cattle. It is stated upon good authority that one wealthy Mexican brands from 30,000 to 40,000 calves annually on his haciendas.

The following information concerning the cattle industry of Mexico is taken from Bulletin No. 9 of the Bureau of American Republics, issued July, 1891:

> One of the most important of Mexico's industries is cattle raising. The States of the northern frontier are so well adapted to such purposes that they may be said to be immense cattle ranges. The excellent situation of the lands as well as their generally well-watered condition will, as has been said by persons who have given study to the matter, make Mexico a formidable rival of the Argentine Republic. Lately, Texan and English capitalists have made extensive purchases of lands and live stock in the northern States, and are devoting themselves to the lucrative business of raising cattle for the market. But it is not only in the temperate and cold lands of the northern States that this industry may be carried on. In the warmer latitudes, where the herbaceous vegetation is exuberant and water courses abundant, it offers equal opportunity for success.
>
> The fattening of beeves on ranges well-conditioned for grazing, or which lend themselves to grass growing and are well watered, give excellent results.
>
> * * * * * * *
>
> The States of Durango, Sonora, Chihuahua, Nuevo Leon, Coahuila, Tamaulipas, Vera Cruz, and Michoacan present admirable fields for the carrying on of this

great industry. The rich pasture lands of the latter State feed the thousands of cattle slaughtered for the sustenance of the residents of the capital of the Mexican Republic, which is by no means an inconsiderable number, for during the year 1888 there were 83,228 beeves and 130,263 sheep slaughtered in the abattoirs of the city of Mexico. Some of the States above named are not well provided with water, but it has been demonstrated that with small expense all the necessary water can be provided by the boring of wells. In the State of Guanajuato a company, under the patronage of the State government, has bored wells and begun the breeding and fattening of cattle on a large scale. This company has imported into the country a considerable number of specimens of the best breeds of horned cattle from the United States and elsewhere, and judging from appearances its efforts are meeting with gratifying success.

Mexico raises great numbers of cattle for the United States, and does so under better conditions of climate than the latter country, for the stock raisers of this country lose thousands every year owing to the rigorous winter and severe summers, while in Mexico perennial spring smiles on man and beast.

Statistics show that in 1883, in the northern States of Mexico alone, over an area of 300,000 square miles there roamed 1,500,000 horned cattle, 2,500,000 goats, 1,000,000 sheep, 1,000,000 horses, and 500,000 mules. During the same year there were 20,574 cattle ranches in the country, valued at $515,000,000, which number and value have increased considerably in the last seven years.

MEXICANS SEEKING A MARKET.

Previous to the passage of our tariff act of July 24, 1897, a large part of the surplus cattle from the haciendas of these bordering States found a market in the United States whence they were taken for pasturage in dry seasons and for feeding. The number thus brought over the border was sometimes as great as 400,000 annually. The tariff then was 20 per cent ad valorem, but since 1897 it has been $3.75 per head for animals valued at $14 or less, and the annual importations have fallen to about 100,000.

Thus was created a situation which alarmed the Mexican cattle raisers, who found their surplus of several hundred thousand cattle thrown back upon them, and they were under the necessity of finding other markets. In seeking such markets they have discovered that, in order to meet competition, they must produce an animal that is worth shipping, and one that will sell when it is shipped. In other words, they must be able to ship animals which are much larger than the native stock, and which carry a large percentage of the blood of the well-known beef breeds. The Mexicans are now looking to England as an outlet for their cattle, and their purpose in importing our pure-bred bulls is to build up their native herds so that the product will sell well abroad.

OUR EXPORTS TO MEXICO.

Our exports of cattle to Mexico, which are probably all breeding animals, have been increasing recently. A table is compiled, which shows the number and value, as well as the average price per head of the cattle exported to Mexico during the years 1893 to 1900, inclusive. These figures are taken from the monthly reports of the Bureau

of Statistics of the Treasury Department. For use in making comparisons and for general interest the number and value of the sheep, hogs, and horses exported to Mexico are also given. The table follows:

Number and value of cattle, sheep, hogs, and horses exported to Mexico, 1893 to 1900, inclusive.

Year.	Cattle.			Sheep.		Hogs.		Horses.	
	Number.	Value.	Average value.	Number.	Value.	Number.	Value.	Number.	Value.
1893	663	$38,367	$57.86	1,261	$4,417	977	$34,670	.....	.....
1894	2,150	35,331	16.31	5,538	8,648	1,305	16,555	.....	.....
1895	887	34,593	39.00	1,708	8,047	8,105	97,675	.....	.....
1896	861	28,441	33.03	5,373	14,121	28,848	345,056	1,198	$73,074
1897	701	36,854	52.57	2,077	8,275	9,494	107,646	1,318	70,672
1898	2,500	94,404	37.76	3,179	12,205	3,305	36,014	1,733	99,360
1899	3,236	138,223	42.70	2,514	11,112	8,104	107,341	1,414	98,065
1900	3,201	140,119	43.77	3,509	13,503	2,095	24,534	994	96,780

POOR CATTLE IMPOSED ON MEXICANS.

It is stated above that probably all of these cattle which go from the United States into Mexico are breeding stock. The average price being so low lends color to the oft-repeated charge that most of the cattle which have so far found a market in Mexico have been of very inferior stock. It can hardly be doubted, after reading the statements of our consular officers, that the Mexicans have been grossly deceived by dealers in American cattle. It is pleasant to be informed by Consul-General Barlow, at Mexico, that "of cattle purchased from Americans in the United States there has not been, to my knowledge, a single complaint." This is what Mr. Barlow says concerning the imposition referred to above:

> It must be admitted that at present Swiss cattle are rather more in favor among the native stock raisers than American cattle, not from any lack of merit of really purebred cattle, but because certain unscrupulous dealers have imposed inferior cattle upon native cattle raisers and breeders under the representation that they were purebred American cattle. The deception is, of course, found out sooner or later and reflects in no small degree upon American cattle, or, rather, upon American cattle dealers in general. Of cattle purchased from Americans in the United States, there has not been, to my knowledge, a single complaint. Such cattle have always proved entirely satisfactory.

Various methods to prevent the shipment to Mexico of cattle not registered have been suggested. One consul calls attention to the practice of the Swiss Government of inspecting all cattle exported from that country and issuing certificates of the pedigreed animals. He says the result is that no spurious Swiss cattle have entered Mexico. While this method might be impracticable for the United States Government, it might be practicable for the breeders themselves to organize for the purpose of giving a guaranty with the animals they sell. Such an organization should be so thoroughly representative as to command the respect of the cattle raisers of Mexico.

EXORBITANT PRICES ARE DETRIMENTAL.

There is a general complaint coming up from Mexico that the prices of our cattle are too high. On this point Hon. Leandro Fernandez, Secretary of Fomento (agriculture), says:

> I believe that to promote the importation into this country of fine-blooded cattle from the United States it will be necessary for the cattle raisers of the United States to reduce their prices, for the real obstruction to the importation of American cattle is to be found in the high—I might say almost prohibitive—prices.

The average prices which have been received for our cattle for several years in Mexico do not indicate that too much was asked for good purebred animals. However, the prices asked may have been altogether too high for the kind of cattle offered, since we are informed that so many inferior animals have been imposed upon the Mexicans as purebred. The fair prices asked by the honest breeders of the United States would probably not appear exorbitant to the Mexicans if they knew how greatly superior such animals are to those which have been sold down there as purebreds. The Mexicans will not forget that the object they have in view in improving their herds is to produce a class of animals which will sell in England, and it ought not to be difficult to convince them that the best means to attain this end is by the employment of the very best breeding animals to be had. It was by such methods that the United States reached its present high position with reference to purebred cattle; and Mexico, too, will learn that there is no other method which will lead to preferment.

The breeders of purebred cattle in the United States are not producing a surplus so large that it becomes necessary to sell them at greatly reduced prices. They have a fairly good market at home. The possibilities of increasing the number of breeding animals in this country are great, and the breeders are ready to take up the work whenever they can see that it is likely to prove profitable.

It is quite evident, however, if we may judge by the experiences of men in providing markets for other products, that concessions must be made; that those who have cattle to sell must do something toward creating a market. It would be a far-seeing policy for our breeders to do their utmost to create, not only in Mexico, but in the South American countries also, a market for those classes of breeding animals which we can best produce. When once such a market is created our breeders could bend their energies toward increased production in order to supply the demand which they have created. Therefore it has been suggested that it may be the best plan for our breeders to reduce the prices of animals for export to Mexico until such time as the Mexicans may become convinced that the cattle sent them are all that is claimed for them and that such cattle are indispensable to the success of the object which they have in view.

PRICES OF PUREBRED CATTLE.

The impression appears to prevail to some extent in Mexico that the prices which are asked by the breeders of purebred cattle in the United States are altogether too high, and some of them have the impression that the prices quoted to Mexican buyers are much higher than the animals would bring if sold in the United States. The best answers to such objections may be found in the reports of actual sales made at different points in this country. Below is given some statistics of sales of the different breeds of purebred cattle, which were compiled by Col. F. M. Woods and published in the Breeders' Gazette for December, 1901:

Table showing average prices of purebred beef cattle in 1901.

SHORTHORNS.

Date of sale.	Place of sale.	Number sold.	Total.	Average price.
January 16	West Liberty, Iowa	42	$3,537	$84.20
January 17-18	Kansas City	132	12,615	95.57
February 8	Indianapolis	56	7,825	1?2.15
February 6	Kansas City	59	5,910	100.00
February 12-13	Chicago, Ill	82	15,445	188.35
February 13	Fort Worth, Tex	44	7,645	173.75
February 13	Fort Worth, Tex	2	410	205.00
February 13	Fort Worth, Tex	7	1,652	236.00
February 21	Kansas City	58	6,860	118.30
March 6-7	Kansas City	40	13,845	346.12
March 6-7	Kansas City	20	7,535	376.75
March 6-7	Kansas City	40	7,705	192.62
March 12-13	South Omaha	81	36,845	454.85
March 14-15	West Liberty, Iowa	90	25,755	286.16
March 22	Newton, Iowa	62	13,465	217.20
March 26	Minneapolis, Minn	45	14,780	328.45
March 29	Kansas City	34	9,930	292.00
March 29	Kansas City	12	1,535	127.90
March 29	Kansas City	3	465	155.00
March 28	Mount Sterling, Ill	36	9,665	268.50
March 27	Eden, Ill	41	9,430	230.00
April 3-4	Macomb, Ill	66	7,590	114.55
April 5	Chicago	5	6,080	1,216.00
April 5	Chicago	10	6,835	683.50
April 5	Chicago	15	9,200	613.33
April 5	Chicago	9	7,025	780.55
April 5	Chicago	7	3,940	562.85
April 9	Webster City, Iowa	51	14,065	275.80
April 10	Rolfe, Iowa	50	27,205	544.10
April 11	Victor, Iowa	43	13,630	317.00
April 12	Victor, Iowa	51	27,370	536.65
April 12	Victor, Iowa	5	840	168.00
April 8	Marshalltown, Iowa	21	3,570	170.00
April 17	Sutherland, Iowa	27	8,215	304.25
April 15	Newton, Iowa	33	5,195	157.40
April 17	Indianapolis	54	8,200	152.00
April 22-23	Kansas City	97	21,015	216.65
April 24	Capron, Iowa	52	19,185	368.95

Table showing average prices of purebred beef cattle in 1901—Continued.

SHORTHORNS—Continued.

Date of sale.	Place of sale.	Number sold.	Total.	Average price.
April 25	Collins, Iowa	43	$12,180	$283.25
April 26	Crawfordsville, Iowa	48	7,057	147.05
April 30	Indianapolis	32	6,585	205.75
May 1	Attica, Ind	23	3,580	155.65
May 1-2	Springfield, Ill	78	22,760	280.50
May 9	Indianapolis	38	4,975	130.90
May 14	Madison, Wis	56	13,835	247.05
May 15	Webster, Ohio	14	4,465	318.92
May 16	Osborn, Ohio	35	16,215	463.30
May 17	Williamsport, Ohio	43	11,240	244.35
May 23	Des Moines, Iowa	48	15,360	320.00
May 24	South Omaha	81	7,529	92.95
June 6	Preemption, Ill	57	9,065	171.03
June 4	Chicago	44	31,900	725.00
June 5	Chicago	15	16,095	1,073.00
June 5	Chicago	11	6,990	635.45
June 5	Chicago	15	10,870	724.66
June 5	Chicago	19	10,945	576.10
June 7	Orion, Ill	49	8,275	168.90
June 19	Indianapolis	19	3,945	207.63
August 7	Chicago	43	28,245	656.85
September 3	Hamline, Minn	50	13,450	269.00
September 20	Plover, Iowa	47	9,700	206.40
September 26	Louisville, Ky	37	6,850	185.00
October 3	Newton, Iowa	41	26,590	646.35
October 3	Newton, Iowa	9	7,955	883.90
October 3	Newton, Iowa	3	445	148.33
October 3	Newton, Iowa	1	155	155.00
October 4	Newton, Iowa	41	9,050	220.75
October 2	New Sharon, Iowa	52	18,200	351.15
October 9	Morning Sun, Iowa	18	9,540	530.00
October 9	Morning Sun, Iowa	20	6,065	303.25
October 16	Delaware, Ohio	24	2,780	116.25
October 17	Perry, Ohio	80	6,910	86.37
October 16	Columbus Junction, Iowa	47	5,245	115.50
October 17	Kalona, Iowa	26	6,015	231.00
October 23-24	Kansas City	50	16,840	377.00
October 16	Lindenwood, Iowa	10	1,075	107.50
October 11	Miles, Iowa	39	6,085	156.00
October 29	Sutherland, Iowa	49	16,975	343.00
October 30	Sutherland, Iowa	38	11,880	312.63
October 31	Sutherland, Iowa	52	17,385	344.30
October 30	Newton, Iowa	38	3,610	95.00
November 1	Lancaster, Wis	49	5,115	104.30
November 2	Clarksville, Ohio	43	4,370	101.60
October 29	Montrose, Ky	41	3,380	82.45
October 30	Paris, Ky	59	5,705	96.50
October 31	Winchester, Ky	35	4,050	115.70
October 31	Rockville, Ind	20	2,340	117.00
November 6	Kansas City	44	10,070	228.85
November 7	Chicago	45	50,545	1,123.22
November 5	Mineral Point, Wis	51	9,805	192.30
November 15	West Liberty, Iowa	44	25,565	581.00
November 14	Indianola, Iowa	50	25,330	506.60

Table showing average prices of purebred beef cattle in 1901—Continued.

SHORTHORNS—Continued.

Date of sale.	Place of sale.	Number sold.	Total.	Average price.
November 8	Galesburg, Ill	52	$11,640	$223.45
November 9	Galesburg, Ill	50	7,790	155.80
November 13	Kansas City	50	6,980	139.60
November 12	Kansas City	50	12,915	258.30
November 14	Indianapolis	115	21,195	184.32
November 19	Monroe, Wis	51	7,920	155.30
November 20	Douglas, Ill	30	7,405	246.80
November 15	Mulberry, Ind	33	3,425	103.75
December 3	Chicago	69	43,760	634.20
	ANGUS.			
January 10-11	Chicago	101	17,105	169.35
February 7	Indianapolis	47	6,510	138.50
March 6-8	Chicago	143	68,630	479.95
March 20-21	Kansas City	30	6,510	217.00
March 20-21	Kansas City	87	10,660	288.10
March 20-21	Kansas City	26	5,455	209.80
March 20-21	Kansas City	14	2,570	183.60
April 29-30	Kansas City	103	20,975	203.65
May 7	Indianapolis	41	5,865	143.00
May 8-9	South Omaha	110	24,930	226.65
June 11-12	Chicago	71	18,304	257.81
November 6-7	Chicago	95	16,495	173.63
November 15	Indianapolis	55	5,435	98.80
November 15	Sharpsburg, Ill	25	5,525	221.00
December 5	Chicago	96	33,055	344.00
	HEREFORDS.			
January 21-25	Kansas City	50	21,160	423.20
January 21-25	Kansas City	70	24,135	344.79
January 21-25	Kansas City	25	8,195	327.40
January 21-25	Kansas City	19	11,100	584.21
January 21-25	Kansas City	30	8,350	278.33
February 5-6	Indianapolis	71	16,180	227.90
February 7-8	Kansas City	117	18,810	160.75
February 15	South Omaha	46	8,780	190.85
February 14-15	Fort Worth, Tex	65	15,415	237.15
February 14-15	Fort Worth, Tex	33	7,210	218.50
February 14-15	Fort Worth, Tex	37	6,750	182.45
February 19-20	Kansas City	55	14,275	259.55
February 19-20	Kansas City	20	5,620	281.00
February 19-20	Kansas City	14	3,165	226.10
February 19-20	Kansas City	15	3,665	244.33
February 26-28	Kansas City	45	17,200	383.55
February 26-28	Kansas City	10	2,505	250.50
February 26-28	Kansas City	47	13,515	287.60
February 26-28	Kansas City	48	10,835	225.70
February 26-28	Kansas City	49	13,700	279.60
February 26-28	Kansas City	2	1,360	680.00
April 2-3	Kansas City	165	16,270	98.60
May 8	Indianapolis	76	15,015	200.40
May 21-22	Chicago	98	33,620	343.00

Table showing average prices of purebred beef cattle in 1901—Continued.

HEREFORDS—Continued.

Date of sale.	Place of sale.	Number sold.	Total.	Average price.
September 4-5	Hamline, Minn	71	$14,440	$203.35
September 24-25	Louisville, Ky	65	19,450	299.00
October 8-7	Chicago	79	18,105	229.15
October 9	Chicago	59	7,865	133.30
October 22-24	Kansas City	135	34,190	253.25
November 13	Indianapolis	71	11,475	161.62
November 21-22	National Stock Yards, Ill	112	18,465	164.85
December 4-5	Chicago	96	36,525	380.00

POLLED DURHAMS.

April 8	Marshalltown, Iowa	20	3,955	197.75
April 15	Newton, Iowa	27	4,655	172.00
May 1	Attica, Ind	40	5,145	128.60
May 9	Indianapolis	10	1,240	124.00
May 15	Webster, Ohio	35	11,705	331.57
June 19	Indianapolis	24	9,175	382.33
October 16	Delaware, Ohio	42	8,040	191.44
November 12	Indianapolis	45	8,710	193.50

GALLOWAYS.

October 25	Kansas City	35	4,710	131.75
December 6	Chicago	33	9,405	285.00

RED POLLS.

May 3	Tonti, Ill	42	8,730	207.85
June 18	Fairfield, Nebr	37	9,510	257.03

GENERAL AVERAGES.

Breed.	Number sold.	Total.	Average.
Shorthorns	4,045	$1,136,290.95	$280.91
Angus	894	248,025.00	277.43
Herefords	1,885	458,305.00	240.80
Red Polls	79	18,210.00	230.50
Polled Durhams	243	52,625.00	216.56
Galloways	68	14,115.00	207.57
Grand total	7,214	1,927,570.95	267.20

HOW TO INTRODUCE OUR CATTLE INTO MEXICO.

All efforts for the introduction of breeding cattle into Mexico have heretofore been made by private individuals. This being the case is why it has been an easy matter for unscrupulous men to impose inferior animals upon Mexicans as purebreds. Our own breeders, by some system of cooperation, ought soon to be able to overcome the

prejudice now in the minds of Mexicans, and to adopt methods of shipment and exhibition of cattle which will prove satisfactory to both buyer and seller. The Mexican buyers desire to see the animals which they purchase, and it is useless to expect good prices while they are in their present frame of mind if they are not permitted to see what they are buying. It will take time and fair dealing to overcome this requirement, but no doubt it can be done. The proper thing to do at this time, in opening up a market in Mexico, is to bring the buyer, the seller, and the cattle together.

The methods of reaching the Mexican buyer must be left to the breeders to determine. It seems to be the consensus of opinion of the consular officers that cattle should be on exhibition at all of the principal fairs held in the republic, and also at the larger cities. Proper precautions should be taken to prevent loss when cattle are sent to districts infected with Texas fever. Hon. Charles W. Kindrick, consul at Ciudad Juarez, Chihuahua, says:

> Something should be done to get the purebred stock of the United States before the Mexican ranchmen. It is impossible to take herds of bulls from one part of the State to the other to exhibit them. The railroad facilities are too limited, and it would be out of the question to drive them from place to place across the arid plains and mountains. It occurs to me that something might be done, perhaps under the patronage of Government, to establish an exhibition of purebred stock in Ciudad Juarez. From November to March the breeders could ship stock here where feeding would be comparatively cheap, since hay and grain delivered at El Paso or Juarez is at a nominal price. During the season I mention, the ranchmen, many of them, visit the border, and more would come if such an exhibit existed to attract them. With an arrangement of this kind they could see the stock, could gain all the necessary information about it, and would, no doubt, when properly impressed, buy annually a sufficient number of bulls to give them a high class and heavy strain of range cattle.

KIND OF CATTLE TO EXPORT.

It must be remembered that the demand in Mexico is for the beef breeds. Some Holsteins have found a market there, but they were purchased more for their beef qualities than for their milking qualities. The Mexicans want meat, not milk; and since the practice is beginning to be adopted there of selling animals by weight instead of by the head, as has been the custom heretofore, the demand is for large animals.

The point is made by some importers into that country that the blooded stock centers of the United States are north of what is known as the Texas fever line, and therefore those centers can not be drawn upon for supplies, owing to the fact that the cattle would contract Texas fever and in all probability die. It is suggested by one of the consuls that animals for export to Mexico should, consequently, be drawn from the Southern States, where the cattle are all supposed to be immune. A distinction should, however, be made between

infected and uninfected sections of Mexico. The elevated portions of Chihuahua and Sonora and probably of other States of Mexico are apparently free from Texas fever infection, and if protected by a quarantine line such as we have in the United States would remain safe for our Northern cattle. It would not be advisable to send cattle from our fever district to these regions, as they might carry infection to the susceptible animals raised there, and thus create a bad impression. Cattle from our Southern States might, however, be used with advantage in the coast districts or other infected parts of Mexico. These infected districts might, also, be supplied with cattle made immune by inoculation, a method now being used for improved cattle sent from our Northern States to Texas and other States within the fever district. Experiments with reference to this method of immunization have been conducted at the experiment station of the Bureau of Animal Industry.

MEXICAN GOVERNMENT REGULATIONS.

A few months ago the Government of Mexico made an amendment to its tariff laws with reference to blooded cattle, wherein during the year ending June 30, 1902, blooded cattle are admitted free upon the presentation of a certificate signed by any Mexican consul as evidence that the cattle are purebred. Heretofore a pedigree of each animal was required. It is believed that present concessions will be continued.

LITERATURE IN SPANISH LANGUAGE.

All literature of an advertising character which is sent to Mexico should be printed in the Spanish language. This is a point which ought to suggest itself to breeders; but it is true that much advertising matter which is printed in the English language is sent down there. The easier it is made for the Mexicans to understand the points we are making for our purebred cattle, the more certain are we to be able to do business with them.

BREEDERS' ORGANIZATIONS.

American Shorthorn Breeders' Association, John W. Groves, secretary, Springfield, Ill.

American Hereford Cattle Breeders' Association, C. R. Thomas, secretary, 225 West Twelfth street, Kansas City, Mo.

American Aberdeen-Angus Breeders' Association, Thomas McFarlane, secretary, Harvey, Ill.

American Galloway Breeders' Association, Frank B. Hearne, secretary, Independence, Mo.

American Devon Cattle Club, L. P. Sisson, secretary, Newark, Ohio.

American Sussex Association, Overton Lea, secretary, Nashville, Tenn.

The Red Polled Cattle Club of America (incorporated), J. McLain Smith, secretary, Dayton, Ohio.

American Polled Durham Breeders' Association, Fletcher S. Hines, secretary, Indianapolis, Ind.

American Polled Hereford Cattle Club, Warren Gammon, secretary, Des Moines, Iowa.

Brown Swiss Cattle Breeders' Association, N. S. Fish, secretary, Groton, Conn.

LETTERS FROM CONSULAR OFFICERS.

CHIHUAHUA.

From W. W. Mills, United States consul at Chihuahua, Mexico, dated April 13, 1901:

This consular district, comprised of the southern half of the State of Chihuahua, is one of the best cattle raising districts in Mexico. Last year one of the native cattle kings sold 36,000 head of steers, that being only the increase of his herds. These are mostly the small Mexican breed of cattle.

Of recent years some blooded bulls have been introduced from the United States, and only from the United States, and turned out with these Mexican herds with satisfactory results. The gentleman mentioned above alone imported 100 head of these bulls in 1899 and 64 head in 1900. Other ranchmen imported also, but I can not learn the total.

These bulls were three-quarter grade Herefords and cost, delivered at El Paso, $65 gold per head. To this must be added the import duty of 2 cents, Mexican currency, per kilo, which means about $6 gold per head for 3-year-olds and up. Then we must add railroad freight to the point where the animals are disembarked.

The demand for these animals will continue to increase, but I can not suggest any new means of stimulating it. I have little faith in printer's ink and pictures for Mexico. A knowledge of the Spanish language and the confidence of the ranchmen are most important.

I believe it would be a paying business to bring purebred bulls and cows to Mexico and breed them together here. The Mexicans would be more willing to buy home-raised stock, and possibly the improvement would be more rapid.

CIUDAD JUAREZ.

From Charles W. Kindrick, consul at Ciudad Juarez, Mexico, dated April 15, 1901:

For several years past there has existed in this consular district a demand for purebred cattle to be used for the purpose of improving the hardy Mexican stock. This demand, however, has been slight, considering the large ranching area. American and English ranchmen have been practically the only cattle raisers to realize the value of introducing purebred stock. They are now constantly adding Hereford and Shorthorn bulls to their herds. From the beginning they have been cognizant of the necessity of crossing the purebred animals with the natives, and now on many of their ranches the stock is heavier, more easily fattened, and commands better prices than formerly.

The Corallitos range, owned by New York people, and comprising about 1,000,000 acres, is stocked with approximately 30,000 head of cattle, nearly all, or

about 90 per cent, of which have been bred from blooded Herefords and Shorthorn bulls and native cows. From 100 to 200 head of the best bulls obtainable are brought by this company annually from northern Texas and Kansas. It requires this addition each year to keep up the percentage of increase in the herds, largely on account of the nature of the range upon which they live. The rainy season in northern Chihuahua commences in July and lasts from six weeks to two months. The grass then gets practically its only annual growth and the cattle have about four months of grazing, when development is marked. For eight months in the year they progress slightly, since the grazing is sparse and scarcely sufficient to support them against the ensuing rainy season. During the eight dry months from 20 to 30 acres of average ranch land is necessary to the maintenance of each head of stock. On account of this dryness and lack of sufficient grazing for developing purposes for eight of the twelve months, the bulls become impotent, and the cows, unless they are natives or are interbred, become sterile. This is the principal reason why a fresh importation of bulls is annually necessary on a Chihuahua range.

It has been proved by the American ranch owners that the fine bulls introduced and bred with the natives increase the total percentage of production. More important still, there is a decided increase in the weight of the marketable stock thus produced.

In this district, the San Pedro range (125,000 acres) and the Corallitos range (1,000,000 acres) make annual importations from the United States of fine purebred bulls.

Ex-Governor Terrazas, of this State, the largest cattleman in Mexico, has more than 3,000,000 acres of grazing lands. Last year, as an experiment, he purchased a carload of fine bulls in Kansas and introduced them on one of his many ranges. There is no doubt that as soon as the good results of this experiment are visible he will import annually hundreds of fine bulls.

Mexican ranchmen have not purchased the fine stock nor introduced it on their ranges. The reason why they have not done so is mainly a lack of knowledge of what the results would be. They have been unable to realize why they should pay from $75 to $125 (gold) for a fine bull when they sell their cattle at so much per head and have no reason to complain of the productiveness of the native stock. There is no doubt, however, in my opinion they will follow to a large extent in the course of time the example set by the American ranchmen and ex-Governor Terrazas. There is another reason why they will soon be induced universally to improve their herds. A large packing house was recently established at Chihuahua. The stock it uses is purchased from the ranges according to weight and not by the head. The native cattle are invariably thin for most of the year, and are not heavy at any time. In fact, they have small frames, and even when corn-fed and fattened do not approximate the weight of the animals bred from the fine imported bulls and native cows.

Something should be done to get the purebred stock of the United States before the Mexican ranchmen. It is impossible to take herds of bulls from one part of the State to the other to exhibit them. The railroad facilities are too limited, and it would be out of the question to drive them from place to place across the arid plains and mountains. It occurs to me that something might be done, perhaps, under the patronage of Government to establish an exhibition of purebred stock in Ciudad Juarez. From November to March the breeders could ship stock here where feeding would be comparatively cheap, since hay and grain delivered at El Paso or Juarez is at a nominal price. During the season I mention the ranchmen, many of them, visit the border, and more would come if such an exhibit existed to attract them. With an arrangement of this kind they could see the

stock, could gain all the necessary information about it, and would no doubt, when properly impressed, buy annually a sufficient number of bulls to give them a high class and heavy strain of range cattle. With cattle selling by weight, it would require no persuasion to convince them of the necessity of introducing the purebred animals among their native herds.

The following item, which appeared in a recent number of the Mexican Herald, may not be uninteresting in this connection:

"A movement has been started in this State (Chihuahua) for the breeding of half-breed cattle on a large scale. Since the purchase of Sainapachic by Mr. Oxsbeer some time since the matter has been brought prominently before cattlemen of the United States, and is already bringing results. The latest venture is said to be on the part of William Humphrey, who is reputed to be the largest individual Hereford breeder in the United States, his ranch at Ashland, Nebr., containing thousands of head of blooded stock. He has investigated conditions here, and is now negotiating for the purchase of the great Purisima ranch in the district of Bravo, and situated along the Rio Grande. The hacienda contains over 3,000,000 acres, capable of maintaining 30,000 head of cattle. A well-known stockman of El Paso recently made a visit to Chihuahua for the purpose of examining the titles which are held by the present owners (Charles Davis and the heirs of Jose Valenzuela), and, if they are found to be satisfactory, the deal will probably be made. If this is done, Mr. Humphrey will stock the ranch with native cattle and thoroughbred bulls."

On August 6, 1901, Mr. Kindrick sent some further information relative to preparations for cattle raising on an extensive scale. He writes:

What is said to be the largest ranch deal ever made in the southwest or northern Mexico has just been closed. Capt. Charles David, of El Paso, Tex., transferred the David ranch, in northeastern Chihuahua, Mexico, to the Riverside Land and Cattle Company, of Nebraska. The ranch comprises 1,200,000 acres, and lies along the Rio Grande. The price paid was 30 cents per acre, or $360,000. The purchasers are William Humphrey, of Ashland, Nebr., and George E. Ricker, of Quincy, Ill. Mr. Humphrey is president and general manager of the Riverside Hereford Company, of Ashland, Nebr., and Mr. Ricker is an Illinois banker. These gentlemen are said to be the largest Hereford breeders in America.

Mr. Humphrey states that the ranch just purchased will be stocked with 750 fine Hereford bulls and 15,000 common cows immediately. It is his purpose, he says, to give Mexican ranchmen an object lesson as to the value of purebred cattle, so that they will become purchasers of the fine bulls now raised in the United States.

Mr. Humphrey will at once construct 300 miles of barbed wire fence, and make other improvements.

The purchasers of the ranch state that it is their intention to establish a permanent exhibition of fine stock at El Paso, Tex.

DURANGO.

From Walter H. Faulkner, United States consul at Durango, Mexico, dated April 11, 1901:

The number of American investors coming here in quest of business openings has been constantly increasing the last few years, and quite a percentage of them have put their money into ranches and ranch land. As would be supposed, not

content with the cattle produced in this country, they have all to a greater or less extent given their efforts and attention to a betterment of the grade by importing purebred animals from the States and mixing them with the Mexican stock. This has roused the Mexican ranchmen to realization of the superiority of American cattle and the advantages to be derived from interbreeding the two grades, until now a great many haciendas in this section have their limited number of purebred animals mixed in with the "Longhorns." It should be understood, however, that the move in this direction is only in its inception; that the demand for a better grade of cattle has only recently been created and is bound to greatly increase from now on.

The best method that presents itself to me for bringing such cattle to the notice of this people is one that has within the past year or so already been put into execution by one or two individuals for a short length of time, viz, bringing a few cars of blooded animals here, renting a suitable place near the city (in securing which there is no great difficulty), and keeping them on exhibition and for sale.

There could hardly be more room for improvement in a grade of cattle than there is here in Mexico. Mexican ranchmen are coming to realize this fact and are beginning now to remedy the evil by importing and mixing with the native stock some of the best breeds of the United States.

MEXICO.

From Andrew D. Barlow, consul-general at the City of Mexico, Mexico, dated June 5, 1901:

There is a demand in all parts of Mexico where cattle are raised for purebred animals to improve the native stock. The demand for purebred dairy stock is the most marked, and the breed of dairy stock in this immediate vicinity and in the northern part of the republic has greatly improved in the past few years. The growing demand for purebred cattle is illustrated by comparing the value of cattle imported into this country for the fiscal year of 1892-93, which amounted to $9,042, with that for 1898-99, which amounted to $162,073, the importation of cattle into this country being confined almost entirely to purebred animals.

Every encouragement is being offered to the improvement of native cattle breeds by the Government of Mexico and by many public-spirited citizens of the republic. In August last, by special act of Congress, all impost of duties on purebred cattle imported for breeding purposes were remitted, and I am informed by the Honorable Leandro Fernandez, Secretary of Fomento, that since that time he has investigated requests for the remission of duty on 146 head.

Up to the present time importations of purebred cattle into this country have been confined almost exclusively to Swiss and American cattle. It must be admitted that at present Swiss cattle are rather more in favor among the native stock raisers than American cattle, not from any lack of merit of really purebred American cattle, but because certain unscrupulous dealers have imposed inferior cattle upon native cattle raisers and breeders under the representation that they were purebred American cattle. The deception is, of course, found out sooner or later and reflects in no small degree upon American cattle or, rather, upon American cattle dealers in general. Of cattle purchased from Americans in the United States there has not been, to my knowledge, a single complaint. Such cattle have always proved entirely satisfactory, but their cost is so high as to be almost prohibitory, as will be shown more in detail in succeeding paragraphs. The practice of the Swiss Government of inspecting all cattle exported from that country and issuing certificates of the pedigrees of all exported cattle has prevented the importation into this country of any spurious Swiss cattle. In this high altitude Swiss cattle, when judiciously crossed with native cows, give a breed nearly as good as the original stock and less liable to sickness. American

purebred cattle have not done well on the large ranches where they have been turned out with the herds, not being used to the hardships of ranch life; but where they have been kept penned up and cared for as in the United States they have given good results. The only objection to them is their high price. The breeds of American cattle generally imported into this country are Holstein-Friesians, Durhams, and Herefords. These cattle easily become acclimated in the northern part of the republic. A few wealthy cattle raisers have experimented with the breeding of fine cattle with rather unsatisfactory commercial results, but these results appear to have been due to conditions which could be remedied.

I have interviewed a number of leading local stock dealers who supply the Mexican markets with beef cattle, and it was stated by them that the meat industry in Mexico is as yet in its early stages of development, and quality now counts for very little in beef cattle. It would seem, however, that it is merely a matter of educating the tastes of the people, who are able to pay high prices for meat, to demand a better quality than they are now able to buy in the local meat markets. Some local meat dealers with whom I have conversed have expressed the opinion that a demand for high-grade meat could be created here and have expressed their willingness to handle such meat if they could procure it regularly. One or more packing houses are projected in this republic by American firms. A packing house is said to be now in course of construction near Uruapam by the American Beef Company, and another is said to be under way in the northern part of the republic—out of my district, however—by another American firm. These packing houses will presumably raise the standard of marketable beef in this republic and therefore create a demand for better grades of cattle. I understand that they themselves are arranging for the importation of purebred American cattle for breeding purposes.

Among cattle raisers whom I interviewed were Manuel Sainz and Juan Martinez del Cerro, wealthy men, owners of fine dairy cattle, and men of considerable experience in the raising of fine cattle. I will reproduce their joint interview as nearly verbatim as possible, as containing the gist of the remarks made by all the cattle raisers I have interviewed on this subject:

"Some of the finest cattle ever seen in Mexico," they said, "have been brought here from the United States or are the offspring of American-bred parents. We need for our dairy business cows which will produce large quantities of milk, the quality of which does not cut any figure with us, because we have only a limited demand for cream and rich milk on account of the slight appreciation of our people for rich butter and cheese. We prefer the Holsteins on this account, but have given up the buying of them in the United States because the price asked for purebred cattle by American raisers is too high. This is no fault of the American raisers, but is due entirely to the dishonesty of a certain class of dealers who make a practice of importing inferior animals, representing them to be purebred Holsteins or Herefords, or whatever the breed may be, which deceive ignorant buyers, and on account of the easy terms offered by the dealers, find a quick market.

The purchasers of this inferior stock find their customers among the more ignorant, and sell the product of bulls and cows bought by them as genuine, at prices with which the owners of purebred American cattle can not compete. Of course, the inferior stock is soon found out by the purchasers, and, as a result, American cattle are discredited, and breeders find it more to their advantage to bring their stock from Switzerland, where the law protects the legitimate raiser and makes it impossible for the dishonest dealer to palm off inferior stock upon the ignorant. With every bull or cow brought from Switzerland we receive a certificate from the authorities giving the pedigree of the animal, and we do not remember a single instance of deception practiced with Swiss cattle. If the

Government of the United States would adopt some measures to protect the trade against the tricks of irresponsible dealers and stop the exportation of inferior cattle under false pretenses, we have no doubt that American cattle would soon become the most sought after in Mexico."

From personal knowledge, I believe the views of Messrs. Sainz and Cerro to be well founded in fact. I will also give the views of Ernest Gerhart, importer of cattle, as follows:

"I believe that the most effective way to introduce purebred American cattle into Mexico would be to establish show and sales stables in the city of Mexico and another at Chihuahua, managed in the interests of the principal cattle breeders of the United States, particularly of the middle West, by an American who has had experience in this country and has a ready command of its language. The expenses of such a depot would probably not exceed $250 per month (Mexican currency), including salary, rent, help, and feed. If the interested parties would be satisfied to sell their animals, at least for the first year, on the basis of the prices they obtain at home, with the proportionate freight and expenses of their joint agency added, I believe that a great many more cattle would be imported than heretofore. A more widespread introduction of Durham and Hereford bulls in the northern part of the republic would benefit the United States, which buys a considerable number of young range cattle from the State of Chihuahua, and the same class of bulls and Holstein cows would find increased demand in the southern part of Mexico."

I will quote a statement made to me by the Hon. Leandro Fernandez, Minister of Fomento, as follows:

"I believe that, to promote the importation into this country of fine-blooded cattle from the United States, it will be necessary for the cattle raisers of the United States to reduce their prices, for the real obstruction to the importation of American cattle is to be found in the high, I might say almost prohibitive, prices."

This remark is worthy of serious consideration. It would seem to me to be expedient for American cattle raisers to sell stock to Mexican cattle raisers at very low prices for a time, to encourage the importation of American cattle into this country, and to create a steady demand for the American pure breeds.

In 1894 an organization was formed in Coyoacán, a suburb of this city and the immediate vicinity, of private individuals or individuals acting in a private capacity, known as the Coyoacán Fair Association, or the Sociedad Anónima de Concursos en Coyoacán, which association held a live-stock show in the same suburb in January, 1895, and has held a similar show each year since that time. Cattle form so important a part of this live-stock show that it may almost be called a cattle show. The object of the association is purely to encourage the breeding of fine stock in Mexico, and it is doing a most praiseworthy work in that direction. For exhibitors of cattle or other stock at this annual fair, all expenses of transportation and maintenance are paid by the association, whether the exhibitors be native or foreign. The fair association received the assistance of the Government in the matter of transportation. At the last annual fair of this association, held in October last, several American cattle raisers had exhibits brought thither from the United States, and other American cattle raisers in this republic were well represented. In the matter of prizes the American exhibitors were very successful. The fair was well attended by representative stock raisers, and the American exhibitors sold a number of head of cattle to them. I would recommend that American raisers of purebred cattle be well represented at the succeeding fairs of this association.

Summing up the methods by which the importation of American purebred cattle into this Republic may be encouraged, I would respectfully suggest the following measures:

First. An inspection of alleged purebred cattle exported to foreign countries

by the United States Government, to protect the honest cattle raisers in the United States and to preserve the high reputation of American purebred cattle abroad. If this be impracticable, I would respectfully suggest—

Second. That the leading raisers of purebred cattle in the United States cooperate to prevent the exportation of inferior cattle from the United States to foreign countries under the representation that they are purebred. An organization of American raisers of purebred cattle, with funds appropriated for that purpose, could probably prevent in large measure the imposition of inferior cattle upon cattle raisers in this and other foreign countries under the representation that they are purebred by assisting the government of such countries and cooperating with them in enforcing their laws. Such an association might register purebred cattle and become responsible to foreign buyers for the accuracy of pedigrees issued by it. It might maintain in this and other foreign countries permanent cattle exhibitions and employ competent men to study the particular needs of each section and ascertain what breeds of American cattle would do best in that section. I believe that the expenses of such an association would be repaid many times over to the individual members.

NOGALES.

From J. F. Darnall, consul at Nogales, Mexico, dated April 15, 1901:

The improvement of the native cattle in northwestern Mexico is comparatively in its infancy. On the border between Mexico and Arizona this matter has assumed some importance. Mr. Colin Cameron, of Arizona, one of the largest stockmen on the border, and a few others of like note have for the past few years been giving this subject much attention, and, as I believe, with profitable results to themselves and a wonderful benefit to the cattle raisers of Mexico. The improvement in the stock of cattle has been marked throughout a large space of country by the efforts of these few gentlemen. On the border the dairymen, who are operating on a small scale, as fast as they can are changing their native cows to the improved breeds of the United States. Persons engaged in shipping such cows to Nogales for the past two years find a ready market for them at remunerative prices.

One other important factor in improving the native stock of Mexico is the Mexican Hereford Breeding and Importing Company, of Chihuahua, Mexico. This company is composed of gentlemen from the United States, with Mr. J. M. Curtice, of Kansas City, as president. The Mexican Farmer and Stockman, a journal published by this company both in the English and Spanish language, with illustrations, is being widely distributed. Where it is desirable to prosecute the business of introducing purebred cattle into Mexico on an extensive scale, I am not able to conceive of a better plan than that adopted by the aforesaid company. On a less extensive scale, according to my judgment, the only true road to satisfactory results is to bring seller and buyer together, coupling this with the establishing of agents when necessary. This would not be hard to do, for it must be remembered that American herdsmen are all the time becoming more and more numerous in Mexico. Notwithstanding this latter fact, I would urge the importance of the representatives in Mexico being able to understand and speak the Spanish language.

Diverging somewhat from the question in hand, I wish to say in a general way that the quicker the American exporter abandons the idea of taking and holding the trade of Mexico by correspondence only, the better. The door of opportunity is opened in northwestern Mexico for the breeders of purebred cattle. The field is large. Sonora alone embraces about 76,000 square miles. Cattle raising must ever be one of the principal industries, not of Sonora alone, but of the adjoining States.

MATAMORAS.

From P. M. Griffith, United States consul at Matamoras, Mexico, dated March 23, 1900:

Mexico contains a great many haciendas admirably adapted and almost exclusively devoted to the raising of cattle. A fact which is attracting general interest here is that every season shows an improvement in the care taken of the animals, and also in the class imported. The stockmen throughout this country are taking such an interest in this direction and have imported so many purebred cattle from the United States that on many haciendas one may find animals which compare favorably with those on noted breeding farms in the North. In former years they consisted exclusively of the old long-horned Spanish and Mexican types, which have large bones and frames and long legs but are deficient in flesh. This deficiency is certainly not due to the country, for the climate, grass, water, and general topography are decidedly favorable to animal growth and comfort, and while it is a generally recognized fact that Mexican stock is inferior to United States animals, it is the prevailing opinion that a cross between the pure blood of the North and the cow acclimated here produces a large, healthy, vigorous offspring, with an unusually compact muscular development.

MONTEREY.

From Philip C. Hanna, consul-general at Monterey, Mexico, dated April 17, 1901:

For the past four years the exportation of cattle from Mexico has been large, due to the American-Spanish war and the consequent high price. Now, however, the conditions have changed, so far as exportation is concerned, but the exodus, if I may use the term, during the term adverted to has given the Mexicans a new idea as to the breed of cattle, and their eyes are now open and directed to the United States for a better breed. It is thought in this connection that special attention should be given by those interested in our country to the exportation into Mexico of the Herefords and Holstein cattle and Angora goats. In the judgment of this consulate-general, the Hereford is more adaptable to Mexico; but the opinion is divided as to this, save that many prefer the Jersey. As to goats, there is no more profitable business in Mexico than the raising thereof. In the business of this office the shipment of hides of that animal constitutes one of the most important items. There is a large field for the introduction of the Angora, and to anyone who undertakes it this consulate-general predicts great success. As to the introduction of animals of the character reverted to—as, in fact, anything else—those interested must send a competent person, thoroughly conversant with the Spanish language and the business, and associate with the native element interested. Without doubt the blooded-stock associations in the United States could introduce "stock shows" in the cities and towns of Mexico that would make a valuable impression on the Mexican stockmen and would prove an advantage to stock raisers of both countries. If any of our people wish to resort to advertising, our consuls will gladly furnish them with such lists of Mexican newspapers in the Spanish language as will be most likely to reach the Mexican ranch owners. The field is simply immense, and it only remains with the breeders in America to embrace it.

SALTILLO.

From Charles Burr Towle, at that time United States consul at Saltillo, Mexico, dated April 20, 1901:

There is not at present any demand within the limits of this consular district for purebred cattle for improving native stock.

This is a mountain consulate, at an altitude of 5,500 feet above sea level, and there are no cattle ranches within its boundaries, the country not being suitable for same. Conditions here differ very much from those a few hundred miles north or south in Mexico, there being practically no breeders of cattle in this vicinity. There are a very few dairymen who import their stock; but there is no market here which would warrant breeders in the United States in making an effort to bring the attention of the few stock growers to their cattle.

VERA CRUZ.

From William W. Canada, United States consul at Vera Cruz, dated April 30, 1901:

There is but a very small demand for purebred cattle in this district, and there have been but very few brought into the district from the United States, as they do not do well if brought direct to this low altitude. I have been informed that but very few live long. They frequently take sick in the night and are dead by morning.

The best method seems to be to ship them to the higher altitude of Mexico first, and acclimate them by bringing them down to the sea level by degrees. No doubt it is better to breed them in higher altitudes of Mexico and bring them down when they are less than a year old.

I am of the opinion that a large ranch of purebred cattle located near Jalapa or Orizaba in this State could do a good business.

The American Breeding Company, of Chihuahua, State of Chihuahua, are doing a profitable business. They publish an illustrated paper, which is sent to the cattle men of the republic, and I am sure that this is the best method of securing the attention of the stock growers of Mexico. I believe that a catalogue, well illustrated with pictures of the various breeds of cattle, placed in the hands of the cattle men would result in many orders. The same is true of high-bred horses, chickens, and dogs.

I directed a letter to Hon. Alexander M. Gaw, who is a special agent appointed by Governor Dehesa of this State, and one to Mr. H. J. Langdon, who lives about 100 miles from here, in one of the best cattle districts; and I inclose their replies. I also inclose a letter from the Mexican Hereford Breeding and Importing Company. [The last letter mentioned contains no information.]

[Inclosure.]

JALAPA, *April 15, 1901.*

DEAR SIR: In reply to your letter of the 12th instant, I would say that the stock men of this section fully realize the unquestioned importance of introducing into their herds heavier cattle in order to improve the native stock.

As to the demand for purebred cattle, by which I understand you mean full-blooded, registered stock, while I know of some instances of the importation of cattle of this class, I am inclined to think that the higher cost and the risk in acclimatizing are factors unfavorable to any very great demand, though there is some demand. There is considerable business in graded stock and cross strains. In reply to your question as to the methods by which the attention of stock growers may be secured, I have no doubt that advertisements in the Mexican newspapers would elicit inquiries.

Yours, truly, ALEX. M. GAW.

Hon. W. W. CANADA,
United States Consul, Vera Cruz, Mexico.

MEXICAN COMMERCIAL COMPANY OF ILLINOIS,
Tlacotalpan, V. C., Mexico, April 28, 1901.

DEAR SIR: This reply to your letter of the 13th instant has been delayed, owing to my absence at the plantation for the past ten days.

Replying to your question as to the introduction of thoroughbred cattle into this country, I will say: I have had many inquiries from Mexicans as well as Americans within the past year asking where and how good cattle could be procured; and while I do not think the demand would be great for some time, I do think if there was some source of supply in this district a good demand could be created.

The best method of introducing them would be to establish headquarters on some ranch in this district, where good shipping facilities can be had for loading on the river steamers, and then sending out circulars to all the American and Mexican ranchers in the Sotavento (south coast of Vera Cruz) district, informing them where they can be had. In this way people desiring good stock could come at small expense to where the cattle can be seen, and make their own selection. This would also apply to thoroughbred hogs, for which there is always a good demand. Following this plan, I think there is no question as to the establishment of a profitable business for the importer, and it would also be of great benefit to the country.

Yours, very truly,

H. J. LANGDON.

Hon. W. W. CANADA,
United States Consul, Vera Cruz, Mexico.

TAMPICO.

From Samuel E. Magill, consul at Tampico, Mexico, dated July 12, 1901:

The demand for purebred stock in this part of Mexico is limited to a very few of the wealthier ranchers, but the need for such animals is great.

The native cow is a fairly good animal, notwithstanding years of inbreeding, and the average of weight would be greatly increased by the introduction of Durham, Hereford, Angus, or Holstein.

Throughout the Huasteca, a fertile district to the south and west of Tampico, may be found some cattle with the marks of better blood than the average, indicating that, in times past, attempts have been made on a small scale to breed up some herds.

About a year ago several carloads of blooded cattle were brought here under contract, but the parties who brought them tried to dispose of another shipment without success, owing to the fact that the first lot was not up to expectations.

The local cattle dealer of means desires good blooded cattle and is willing to pay a reasonable price for what he gets, but will not again order in advance. Three carloads of good animals can be sold here at once.

Animals for this market should be brought here from south of the quarantine line of Texas, as several species of ticks are common here which would endanger the health of animals brought from points farther north.

I am reasonably sure that the cattlemen here will not again buy without seeing the animals first, so would deem it useless just now to send them literature, advertisements, or photographs. The trade will commence when some one here demonstrates the success of improved breeding, and the others will follow as a matter of self-preservation. I believe such example will come from some of our cattlemen moving here, where lands are cheap and grass is good, bringing with them some of the best breeds and giving a practical demonstration of the value of well-bred over common cattle.

I am reliably informed that an American cattle man has been quite successful in the importation of Holstein bulls for breeding to select native cows for dairy purposes. His ranch is near Tuxpan, about 90 miles south of this city. But such enterprises, as a rule, will not be profitable for the rancher until cattle are bought by the weight and not by the head, the latter being the local custom—although the local buyers tell me that, when buying a herd, they take into consideration the size of the animal—and until the retailer in the large cities of the interior demands a better animal with greater development of the loins and hind quarters.

Just as in the United States, the demand of the consumer in Northern States and in Europe for the finer cuts of beef made the packer of the middle West demand a better animal from the feeders of Missouri and Iowa, whose demand in turn of the breeder of the West and Southwest made our breeding cattle what they are now, so will the demand for a better-bred animal in this part of Mexico come, when it does, from the natural market in the cities of the interior and from Yucatan on the feeder of the Huasteca, who will in turn insist upon the breeder of Coahuila and Tamaulipas furnishing him with a better animal, for be it known that almost without exception throughout the Republic of Mexico beef is sold by the retailer to the consumer in hunks cut from the bones with little regard as to the part of the animal from which the hunk comes.

MAZATLAN.

From Louis Kaiser, United States consul at Mazatlan, Mexico, under date of April 16, 1901:

There have been quite a number of American cattle imported into this district. I find that the experiment has proved satisfactory as well as profitable, and I know of no reason why there should not be a good business established in importing cattle to this coast.

In my opinion the best way to call the attention of the native stock raisers to the purebred cattle of the United States, would be for the Secretary of Agriculture to forward printed matter on that subject to the stock raisers and importers in Mexico. If this is not feasible, the exporters of cattle should correspond with the stock raisers here, using the Spanish language if possible.

It is difficult to name the kind of cattle wanted, as some prefer the Holsteins, some the Shorthorns, and some the Polled Angus; but Jerseys are not in demand, owing to their small body. Mexicans desire a large breed of cattle for butchering purposes. Butchers' stock is continually in demand at remunerative prices.

Cattle raising has been given considerable attention by the better class of farmers in Mexico, and the interest will no doubt grow in the near future. In this connection, I would state that one of the largest cattle sales on record was made by a Mexican stock raiser in the adjoining State of Chihuahua, who sold 400,000 head of cattle at one sale.

YUCATAN.

From Edwin Thompson, United States consul at Progreso, Mexico:

There is at present an increasing desire upon the part of cattle owners to import purebred bulls from England and the United States as a means of improving the native stock. Strictly speaking the desire has long been with many of the cattle breeders, but until the present era of exceeding prosperity in Yucatan, by reason of the high price of sisal hemp, their means have not been commensurate with their ideas. Now that they have the money they are going into the importation of fine-bred cattle with enthusiasm. Indeed some of them are going into this line of procedure with an abandon and vigor that is not only childlike but which borders on foolishness. For example, two young men whose incomes are, by rea-

son of present prices of sisal grass, unusually large, thought that they would have a model milk and dairy farm in tropic Yucatan. Accordingly they went to Mexico City (a high cool tableland region and climate), and there inspected and bought at good prices 16 blooded cows and several bulls to serve as a base for their model dairy and stock farms. These animals were indeed fine looking; of a Swiss breed, I think. They were in their element while in the model farms upon the high cool tableland of Mexico; but when brought to Yucatan they sickened and died one by one. Some lived nearly a year, but at the end of a twelvemonth those that were not dead were nearly so, and thus the foolish attempt to make a breed of cold-climate cattle thrive in a hot land like Yucatan came to its certain end.

Among thinking cattle breeders the present idea is to import simply bulls, and thus build up from the small-framed but hardy and well-built native stock a class of cattle suitable to the climate and peculiarities of the soil.

The climate of southern Florida is quite similar to that of Yucatan, and cattle that will endure the climate of the above-mentioned portion of the United States soil will probably thrive in Yucatan. All breeds have been tried here, but cattle breeders have generally settled upon the Holstein and the Durham as the breeds best adapted to stand the rigors of the climate and the forage of the country.

The Durhams are considered the best for meat, but the Holstein the best "all-around" cattle. Mobile has within the last year sent a great many cattle to Yucatan, some for breeding and milking purposes and others for food. A certain percentage of these die from a kind of fever, but many live—enough to produce a decided result in the future breeding of the primitive native stock.

A very large stock raiser of the United States visited me some two years ago, and, after duly studying the native cattle, stated his belief that they were first-class stock to breed upon and produce cattle of a superior class.

I shall be most pleased to answer in detail the queries of any stock sellers in the United States. Any circulars, etc., sent me will be duly distributed where they will reach the persons interested.

NUEVO LAREDO.

From J. F. Kimball, vice and deputy consul at Nuevo Laredo, Mexico, dated April 6, 1901:

There is not much demand in this district for purebred cattle for the improvement of the native stock.

It is generally so drouthy on this frontier that the stock raisers are afraid to invest in fine stock. During the long drouths, which occur here almost annually, the stock have to subsist principally on the cactus and brush, for which the longhorns seem best adapted. Unless irrigation could be made a success, I would not like to venture even a guess as to when there may be anything like a general demand in this section for the higher grades of stock.

The attention of the stock raisers in this district might be attracted, first, by extensive advertising showing the great advantage of raising purebred stock; second, by the stock growers in the States visiting or sending agents to the ranches of this country to explain to the growers here the advantage of the fine breeds over common stock; third, by shipping in exhibits of fine stock, showing them at central points. The high rise in meats within the last few years will, in the near future, lead to a mighty effort on the part of the growers nere to raise a larger class of stock.

LA PAZ.

From James Viosca, United States vice-consul at La Paz, Mexico, dated April 19, 1901:

The barren condition of this peninsula, which is due to its protracted drouths and natural sterility, would seem to make it a most uninviting country for raising stock of superior quality.

During the last months cattle have been dying off in numbers, and those that are left are subsisting entirely on the various species of cacti.

A few experiments have been tried with imported California stock, but these, as a rule, could exist only by keeping them in stables.

As an investment it is far from presenting any promise of success in this district, and consequently I can not suggest any methods to offset the above facts.

ACAPULCO.

From George W. Dickinson, United States consul at Acapulco, Mexico, dated July 10, 1901:

With reference to the inquiry as to whether there is a demand in this consular district for purebred cattle for improving the native stock, I have to report that, after consulting with such ranchmen as come within my reach, there is no demand at present; but, in my opinion, a demand could be easily created by sending good, persistent representatives into the republic to place the matter properly before the people.

TUXPAN.

From Edwin R. Wells, United States vice-consul at Tuxpan, Mexico, dated May 2, 1901:

I report, after a careful examination of a radius of 40 miles, that there are no stock ranches of sufficient size and number which are desirous of improving the small herds that they have. The cost of bringing in improved animals is too great, as they must be landed at Tampico and driven overland to the ranches. The largest cattle ranches here have only about 200 head.

AGUAS CALIENTES.

From A. M. Raphall, United States commercial agent at Aguas Calientes, Mexico, dated April 15, 1901:

There is no demand for purebred cattle in this district. The experiment has been tried and failed on account of the climate, or probably want of care.

REPUBLIC OF MEXICO.

Mr. A. B. Hulit, corresponding secretary of the Kansas Reciprocal Association, with offices at room 14, Office Block, Topeka, Kans., and who has an office also at Chihuahua, Mexico, writes to this Bureau, under date of December 31, 1901, as follows:

I have been interested since my boyhood in fine stock, and when I went to Mexico eight years ago to found a newspaper called Modern Mexico, now published at New York City, I saw there a wonderful field for the sale of our purebred

animals. I at once began the study of the situation, finding that under the natural conditions obtaining there, so far as climate and grass were concerned, Mexico is a natural breeding ground for cattle. I found there, however, a lack of interest on the part of the native stockmen with reference to the subject of improving their herds that was indeed striking. In fact, bad laws, poor shipping facilities, coupled with the disadvantage of poor markets and still poorer packing facilities, did not justify a very great interest; but conditions have changed rapidly, for laws are amended and altered, railroads are ample, and new packing companies are springing up, so that ere long Mexico will be a cattle country in all that is necessary to insure a profitable business.

High lands are fairly well grassed and watered, and being at so high an elevation, the cattle are not affected with Texas fever or any other injurious diseases. Sheep find here a natural home, but there is occasionally some scab, due to neglect, although, owing to the mildness of the climate, it is not serious. Dipping facilities are now being introduced rapidly, and these will soon make scab a thing of the past. Ranches are owned, which fact prevents the passing of flocks from one section to another, thus preventing the spread of this disease.

It is not safe to take our Northern cattle to the tropics or semitropics, because of the prevalence of the Texas fever tick; those regions will have to be stocked from the Southern States, where cattle are immune from Texas fever.

On the whole, I see no good reason why, owing to the fact that the native stock in Mexico is very poor, that we can not sell millions of dollars worth of our stock there. The cattle which I took to Mexico were taken upon the invitation of the Mexican Government, to be exhibited at the Government fair held at the City of Mexico, where they won the grand prize as the best herd of cattle. They were Herefords, and created no small amount of interest, as they were the first of this kind of cattle ever exhibited there. The President presented me the grand prize in the presence of many of the leading men of Mexico, and spoke on this occasion in such a manner that I feel able to say to my fellow-stockmen of America that the Government of Mexico and her leading men appreciate our stock and will make us welcome in that country.

O

U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF ANIMAL INDUSTRY—BULLETIN NO. 42.

D. E. SALMON, D. V. M., Chief of Bureau.

EMERGENCY REPORT ON SURRA.

BY

D. E. SALMON, D. V. M.,
Chief of Bureau of Animal Industry,

AND

CH. WARDELL STILES, PH. D ,
Pathologist of Bureau of Animal Industry.

WITH A

BIBLIOGRAPHY OF SURRA AND ALLIED TRYPANOSOMATIC DISEASES.

BY

ALBERT HASSALL, M. R. C. V. S.,
Acting Assistant Zoologist of Bureau of Animal Industry.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1902.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
Washington, D. C., March 29, 1902.

SIR: I have the honor to transmit herewith, and to recommend for publication as Bulletin No. 42 of this Bureau, under the title of "Emergency report on surra," a manuscript prepared by Dr. Stiles and myself in response to a request from the War Department for information regarding the present knowledge concerning the disease known as surra. There is appended to this article a "Bibliography of surra and allied trypanosomatic diseases," prepared by Dr. Hassall.

It is of importance that not only our officers in the Philippines, but also our sanitary officers and veterinarians in this country should immediately become familiar with the chief points concerning this malady. It is true that animals from the Philippine Islands are now excluded from landing in the United States, but it is also true that some animals were landed before it was known that surra existed in the Philippines. The possibility is therefore by no means excluded that such animals have brought this disease with them. If once thoroughly introduced into the United States, surra would cause a loss of millions of dollars, and on that account it is advisable that this bulletin should have a wide circulation so that the essential points in connection with the disease may become known, not only to veterinarians and health officers, but also to stock owners, in which event the malady may promptly be recognized if met with, and the proper measures may be adopted to stamp out the infection.

Very respectfully,

D. E. SALMON, *Chief of Bureau.*

Hon. JAMES WILSON, *Secretary.*

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EMERGENCY REPORT ON SURRA.

SUMMARY.

Surra has been diagnosed among the horses in the Philippines, and has led to the prohibition of landing any animals from those islands at any ports of the United States or of the dependencies thereof.

This disease is caused by a microscopic parasite (*Trypanosoma Evansi*) which lives in the blood, and the evidence now accessible indicates that this organism is transmitted by means of biting flies, especially by members of the genus *Tabanus* (horse-flies); other methods of dissemination are not excluded. It is chiefly a wet-weather disease, and is reported as invariably fatal to horses and mules. It occurs in other animals—such as camels, elephants, dogs, cats, etc.—more rarely in ruminants, and may be transmitted to goats, sheep, and other mammals, but is not yet reported for birds. It is more or less common in India. Its introduction into the Philippines is unexplained, but it has probably existed there for some years past.

Parasites closely allied to this species occur in Europe, Africa, and South America, in some cases causing diseases known as tsetse-fly disease, dourine, mal de caderas, and rat trypanosomiasis. Certain authors believe that some of these maladies are identical with surra.

The chief symptoms of surra are fever, of an intermittent, remittent, and sometimes relapsing type; urticarial eruption; petechiæ on the mucous membranes; progressive anemia and emaciation; ravenous appetite and extreme thirst; more or less paralysis.

Treatment has not been satisfactory, but arsenic has been followed by good results in some cases. Prevention is difficult, but should consist in protecting horses from flies. Immediate isolation of the sick animals and protecting them from flies will result in restricting the disease. In some cases it will perhaps be better to kill and immediately destroy the diseased animals.

From both the military and the economic points of view surra must be looked upon as a very serious matter, and its introduction into the United States would result in very heavy losses.

INTRODUCTION.

ORIGIN OF THE PRESENT REPORT.

A cablegram from Major-General Chaffee, Manila, P. I., asking for information regarding surra, has been referred to this Bureau. This dispatch reached us simultaneously with a preliminary report on a parasitic disease prepared by Dr. John G. Slee, formerly an inspector of this Bureau, so that we conclude that since the report was mailed

the diagnosis of surra has been made. Dr. Slee's letter reads as follows:

OFFICE OF THE INSULAR BOARD OF HEALTH FOR THE PHILIPPINES,
Manila, P. I., October 24, 1901.

DEAR SIR: I inclose a few notes upon a new disease that has appeared in the islands this season among the native and foreign horses (I use the word foreign, as we have American, Australian, and Chinese ponies, in all of which I have noted the trouble). The parasite was first discovered in the blood of a horse taken by myself to the laboratory of the board of health, but for further information and many experiments made I am indebted to Dr. J. J. Kinyoun, United States Marine-Hospital Service.

By a later mail I shall probably be able to give further information, but at present I should like very much to obtain an idea of what we have found, and if you know of a similar parasite—if there is any literature on the subject. Dr. Kinyoun seems to think that it is entirely new.

I am, very respectfully, JOHN G. SLEE, D. V. S.,
Assistant Veterinarian, Board of Health.

Dr. D. E. SALMON,
Chief of Bureau, Washington, D. C.

[Inclosure.]

NOTES ON A NEW DISEASE OF HORSES.[a]

During the past rainy season a disease of a febrile type affecting the foreign and native horses has been noted by the veterinarians.

The history was at first very obscure, the disease usually being far advanced when first seen, the death rate high, and treatment unsatisfactory.

The resident veterinarians and horse owners had noted the same conditions in former years, which they described as calentura, or fever, but did not think it had been so widely spread or the mortality so large as during the present season. Dr. H. H. Muecke, veterinarian of the Land Transportation Corral, says that he had not noted it during the past two seasons, but he was able to give considerable information concerning the disease as it appeared this season in the Government horses.

That the disease was widespread was evident from the reports to the board of health, and investigation showed it to be generally present in the island of Luzon. In one place all the native horses had died, while of the Government stock about one-half were affected.

The first cases in native horses came under notice about the first part of June, and presented swellings of the sheath, legs, and pads under the belly, in many respects similar to those of purpura; the membranes were colorless, hemorraghic spots were present on the membrana nictitans, but no petechial spots were observed on the Schneiderian membrane, as in purpura. These were not seen in the foreign horses. There was always a temperature, very irregular, from normal at times to 105° F. In the native horses the disease would not run a very long course, anorexia appearing in the final stages, followed by death.

When the horses in the corrals became affected the symptoms could be more easily noted. This was simply due to the fact that the native never notices that an animal is sick until it is past recovery. I have seen horses with a well-advanced case being used.

In the corral the sick animal at first showed a temperature of from 103° to 107° F.; pulse full; breathing increased and abdominal; appetite variable, from poor to good, but never entirely lost; the membranes slightly injected, but no hemorrhagic spots,

[a] Same as Slee, 1902a, pp. 819–821.

as noted in the native animal. The swellings of the belly, sheath, and legs soon appear. In some cases they may not be present, emaciation taking the place, but in the native horses swellings seem to be always a marked symptom. At this point the temperature is variable, of an intermittent character, and is not controlled by any of the febrifuges; it may be higher immediately after giving medication than before. Some of the cases last for a long time, being in the hospital for two or three months, and ending in recovery or death. If the swellings suddenly disappear, death soon follows in the native horse; but this is also a symptom of recovery in the foreign horse.

As the disease progresses toward a fatal termination the animal grows very weak, particularly in his hind legs, weaves from side to side when walking, and may go down and be unable to rise.

The feces are of a normal character, no marked constipation or diarrhea being present; the urine seems to be increased in quantity, but as to color or changes I have been unable to note particulars.

Postmortem.—No special lesions are found, the organs and tissues showing an anemic condition, but in some cases abscesses were noted in the stomach and abdominal cavity. The pericardial sac and pleural cavity are always full of a serous fluid, but no appearances of inflammatory changes are present; antemortem clots are found in the heart.

As there were so many cases the disease was supposed to be of a contagious type, but this did not seem probable, as in a stable of several horses one would be affected and the others remain healthy, although the horses were standing side by side and eating out of the same manger.

The character of the disease being so much like malarial fever, the infection was looked for from some other source and a parasite in the blood was suspected. Upon the examination of the blood of a well-marked case, an animal parasite was discovered which was also found in all the cases examined. In the new cases the parasites were seen, and as the cases progressed they increased in number, but toward recovery they grew less and finally disappeared.

The parasite is an animal organism, rather blunt at one end, with a flagellum at the other; in advancing the tail seems to advance, becomes entangled with the corpuscles, and it drags itself forward. It can go backward, but the most of its movements are with the tail advancing. They are of different sizes, the smaller seemingly a male, the larger a female. They often come together, the blunt ends being attached and the flagellum moving very rapidly.

That they have some action on the red blood corpuscles is very evident, as the blood count is diminished and the leucocytes increased.

Where the parasite comes from is not known. To learn its life history will probably necessitate examination of the fly and mosquito, for the disease is widespread, and the affected animals are fed and watered in so many ways (the Filipino depending upon grass and rice, while the Government stock have hay and oats), that this would in a measure exclude feeding as a source of infection.

After the present report was nearly completed, we received, through the courtesy of Dr. George M. Sternberg, Surgeon-General, United States Army, the following report by Drs. Allen M. Smith and J. J. Kinyoun, dated Manila, October 17, 1901:

A Preliminary Note on a Parasitic Disease of Horses.[a]

By Allen M. Smith, *Captain, Assistant Surgeon, U. S. A.*, and J. J. Kinyoun, *Surgeon, U. S. Marine-Hospital Service.*

On October 15, 1901, information was given us by J. W. Jobling, assistant bacteriologist of the board of health at Manila, that an epidemic sickness of an unde-

[a] *Same as Smith & Kinyoun, 1901.*

termined nature was now prevailing in this city, and also that he had just taken a specimen of the blood from a sick animal which on examination revealed the presence of a parasite. Whether this was accidental or was the causative agent of the disease in question, he was unable to say. . On investigation and inquiry, it was learned from the veterinarian in charge of the corral of the quartermaster's department and from the city veterinarian that there was now and had been a fatal epidemic among the horses in Manila, the quartermaster's department having lost over 200 within the last four months.

One of the corrals was visited by us on the 15th instant, where we were shown by the veterinarian in charge 20 horses and mules ill with an undetermined disease. These animals presented the several stages of the malady. Some were quite recently attacked, while others had been ill for over two months.

The symptoms first noticed are impairment of appetite, constipation, fever, and thirst. These are followed within a few days by a rapid and progressive emaciation.

The temperature for the first few days ranges from 104° to 107° F.; the pulse is full and strong. This may be termed the acute state. Then begins an asthenic stage, which may terminate fatally within a variable period, or by a slow convalescence. During this stage, usually within ten days after the onset, there appears a commencing edema above the belly, involving the soft parts; coincident with this, or soon after, the edema extends to the feet and legs. The pulse becomes rapid, weak, and dichrotic; the respiration increased, shallow, and jerky; the gait staggering. Emaciation is rapid and extreme.

The disease has a tendency to relapse; this may occur at any time, even after convalescence appears to have been fully established. The relapses are invariably fatal.

The mortality in this epidemic has been about 75 per cent for American horses and mules and 100 per cent for native ponies.

The gross pathology shows serous effusions into the pleurae, pericardium, and sometimes the peritoneum. There is also a serous exudate into the cellular tissue of the legs and abdomen. The organs are pale, but otherwise normal in appearance.

At the time of our inspection, 5 acute cases were examined, the duration of the attack being from 6 days to 2 weeks. All these animals presented the several clinical appearances as above described.

Blood specimens were taken from the jugular vein of each and examined microscopically shortly afterwards. In 4 of these a parasite was demonstrable. The other was negative, but a specimen taken the following day showed the presence of this same parasite.

On the day following, specimens were obtained from 12 others, all chronic cases, with the result of finding this same parasite in the blood of 4. In 3 they were few, while in the fourth they were present in great numbers; as many as 20 could be seen in one microscope field. The animal from which the specimen was taken had suffered a relapse.

It would appear that the parasite may disappear from the peripheral circulation, or exist there in such few numbers that it is not easily demonstrable after the acute stage has passed. It would require repeated blood examinations to decide this point.

Description of the parasites.

The parasite resembles a whip-like worm, having much the appearance of the *Trichocephalus dispar*. Its length is from 10 to 14 microns, and it is from 1 to 1.2 microns in diameter through its body; the neck is nearly one-half its length, tapering gradually to a point representing the mouth (?). It has a limiting membrane which is well defined; the contour is in most cases symmetrical, but in some the body line is quite irregular. The larger part of the parasite (body) contains granular material and clear spaces, which latter vary in size and number; they are irregularly dis-

tributed, and may encroach on the wall so as to cause irregular outline. The granular material does not extend to the neck.

The parasite is actively motile, having both a vermicular (contractile) and spiral movement. It moves forward in a very peculiar manner; the long whip-like process is thrust forward by a spirillar motion, followed by a contraction of the body.

We have not so far been able to determine its intimate structure, further than the limiting membrane, and the protoplasmic substance of the body.

Two sizes of the parasite have been seen in all the specimens examined; the larger appears to be more numerous and contains considerably more granular material than the smaller, and usually two or more vacuoles. Whether these two sizes represent male and female has not been determined. We are inclined to believe from our observations that these do represent the male and female, because we have observed, in more than half the fresh specimens, the joining of a large and small parasite in such a way as to appear to be something more than accidental.

The pathological change caused by this parasite is a rapid destruction of the red blood cells causing an acute anemia. The changes occur in the blood coincident to the invasion of the parasite. In one horse which had been ill 7 days the red blood cells numbered 3,500,900; the white cells, 14,500. In another, ill 6 weeks, the red blood cells were 3,200,000, and the white were 13,900. The blood of a healthy horse, taken as a comparison, gave red blood cells 6,900,000; white, 9,800. There is also a slight diminution in the amount of hemoglobin—about 85 per cent.

After convalescence has been fully established no parasites can be found; the blood gradually assumes its normal constitution.

The parasite is not confined to the blood, as it can be demonstrated in the serous effusions.

It is quite easy to detect. All that is necessary is to make a microscopical examination of fresh-blood films; a one-sixth-inch objective will suffice. Dried films, fixed, and stained with any of the nuclear dyes.

The organism appears to be a strict parasite. It lives but a short time after removal from the body. The longest time which it has been kept alive in blood serum was not more than 10 hours.

The parasite has many of the properties in common with the filaria and resembles more nearly that of the *Filaria perstans*, only it is smaller and its movements dissimilar. Yet, on the other hand, the clinical history of animals infested by it—the changes occurring in the blood, the lesions observed in postmortem—point very strongly toward its classification with the spirochæte.

The mode of transmission has not yet been studied. It does not appear to be highly contagious, as it does not appear to spread from one to another, even under the most favorable circumstances.

It more nearly resembles malaria in this respect. It is more than probable that its extra corporeal state is different, or another supposition equally tenable is that its intermediate host is some insect, such as the fly or mosquito.

ARMY PATHOLOGICAL LABORATORY, *Manila, October 17, 1901.*

Dr. Kinyoun has now returned to the United States, and, according to information we have received from him, the disease found is beyond question identical with surra. It further appears from his letter that Mr. Jobling made the first observation on the disease in Manila. Dr. Kinyoun adds:

From what I could learn, the disease surra appears to be distributed all over Luzon and has been there for many years. No one seems to know where it came from. I do not think it came from China, as no cases have been reported in Hongkong, where a considerable number of artillery horses are kept.

OBJECT OF THE PRESENT REPORT.

As the disease known as surra is not present in the United States, and as the American text-books on medicine discuss it but briefly, it becomes necessary immediately to place our army officers, our veterinarians, and our live-stock raisers in a position to recognize the malady, should it be introduced into this country. From both a military and an economic standpoint it is also imperative that our officers and sanitary officials now serving in the Philippines should be placed in possession of the present status of knowledge regarding the disease in question. To meet these necessities the present emergency report has been prepared.

IMPORTATION OF PHILIPPINE ANIMALS PROHIBITED.

Immediately upon receiving word that surra existed in Luzon, the Secretary of Agriculture issued the following order prohibiting the importation of any live stock or animals of any kind from the Philippine Islands into the United States:

SPECIAL ORDER PROHIBITING THE LANDING OF ANIMALS FROM THE PHILIPPINE ISLANDS AT ANY OF THE PORTS OF THE UNITED STATES OR OF THE DEPENDENCIES THEREOF.

(*B. A. I. Order No. 92.*)

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., December 18, 1901.

Notice is hereby given to the owners, officers, and agents of all steamers and other vessels of all descriptions plying between the Philippine Islands and any of the ports of the Hawaiian Islands, or between the Philippine Islands and any of the ports of the United States or the Territories or dependencies thereof, and to all stockmen and all other persons concerned in any way or manner in the traffic in animals in or with the Philippine Islands, that certain contagious, infectious, and communicable diseases dangerous to the live stock of the United States exist among the animals of the said Philippine Islands, viz, surra, affecting horses, mules, asses, neat cattle, camels, buffaloes, dogs, and apes; foot-and-mouth disease, affecting horses, neat cattle, other ruminants and swine; and rinderpest, affecting neat cattle and other ruminants.

Therefore, under the authority conferred upon me by the act of Congress approved May 29, 1884, entitled "An act for the establishment of a Bureau of Animal Industry, to prevent the exportation of diseased cattle, and to provide means for the suppression and extirpation of pleuropneumonia and other contagious diseases among domestic animals," I do hereby prohibit the landing at any of the ports of the Hawaiian Islands or at any of the ports of the United States or of any of the dependencies thereof of any live stock or animals of any kind from the Philippine Islands. This prohibition will take effect immediately and will continue in force until otherwise ordered.

JAMES WILSON, *Secretary.*

TERMINOLOGY.

TECHNICAL NAME.

As there is no Latin term signifying an infection with *Trypanosoma*, and as there is considerable confusion in the vernacular names, we

herewith propose to introduce the term *trypanosomiasis*, referring to any infection of any animal with parasites belonging to the flagellate family Trypanosomidæ.

This technical term is therefore analogous to the terms *acariasis*, *ascariasis*, *coccidiosis*, *uncinariasis* (uncinariosis, anchylostomiasis), and *malaria*, in that it is a broad generic term which does not indicate what particular species of the family Trypanosomidæ is present, or what particular host is affected. It does not do away entirely with the names "tsetse-fly disease" and "surra" any more than the term coccidiosis does away with the terms "intestinal, hepatic, or renal coccidiosis," and it has the same general relation to the terms "tsetse-fly disease" and "surra" which the term "malaria" has to "tertian, quartan, estivo-autumnal, human, and avian malaria."

VERNACULAR NAMES.

The technical name *trypanosomiasis* is intended to cover the following vernacular names, compiled from various sources and based either upon prominent symptoms of the disease or upon the hosts of the parasite:

Andar-tap (fever within the body).
Anémie pernicieuse.
Berbad (on wind, wasted away, or spoiled).
Bovine surra (surra of cattle).
Buffalo surra (surra of buffaloes).
Camel surra (surra of camels).
Canine surra (surra of dogs).
Dog surra (surra of dogs).
Doaia (second stage, swelling over the chest).
Equine relapsing fever (at least in part).
Equine surra (surra of horses).
Fish surra (surra of fish).
Galtah (from Gala, meaning throat, as Galtah is a form of surra in camels in which the throat affection is one of the prominent symptoms).
Galtia (melting away).
Glossinose.
Gum-Zaharbad (concealed blood poison).
Horse surra (surra of horses).
Khanhog (first stage, refusing food).
Khusk-Zaharbad (dry blood poison).
La mouche—in Congo.
Marri (plague).
Nikalgaya (passed away, hopeless).
Nagana (tsetse-fly disease).
N'gana (tsetse-fly disease).
Nygana (tsetse-fly disease).
Pernicious anemia of horses (at least in part).
Phenta (fatal).
Phenta-ká-darad.
Phera (bursting of abscess).
Pheta (fatal).
Phetra (abscess).
Phitgaya (burst).
Photra (abscess).
Purana (used up).
Rat surra (surra of rats).
Relapsing fever of equines (Steel, 1886).
Sár (rotten).
Sara (rotten, foul).
Sokra (without flesh and blood, skeleton).
Sukal (drying up).
Surra (third stage, rapid waste).
Tap-dik.
Tapé-dik.
Táp (fever).
Tarai (wet, moist).
Tebersa (three years' duratic
Tibarsa.
Trypanosomose.
Tsetse-fly disease.
Tzetze-fly disease.
Wabai-ki-bokhar (epidemic fever).
Zaharbad (blood poison).
Zherbad (poison wind or miasma).

DIFFERENT KINDS OF TRYPANOSOMIASIS.

At present there are several different kinds of trypanosomiasis usually recognized, but certain authors are of the opinion that at least some of the diseases in question do not in reality represent distinct maladies caused by different species of parasites. We may mention the following in particular:

Surra: A disease of equines, camels, elephants, and certain other animals in India, attributed to *Trypanosoma Evansi.* (See pp. 18, 35.)

Nagana, nygana, or *tsetse-fly disease,* of Africa: Affecting cattle, horses, mules, asses, antelopes, camels, and certain other animals; it is attributed to *Trypanosoma Brucii.* (See pp. 36, 110.)

Dourine, or *maladie du coït,* of Algiers, France, and Spain: It attacks the horse and the ass in particular, but may be transmitted to certain other animals; it is attributed to *Trypanosoma equiperdum.*

Mal de caderas, of South America: It affects horses, asses, cattle, hogs, and certain other animals, and is attributed to *Trypanosoma equinum.* (See pp. 37, 124.)

Rat trypanosomiasis: Attributed to *Trypanosoma Lewisi.* By some authors this parasite is alleged to be identical with the horse surra organism, but it is quite certain that rats may harbor a distinct species. (See pp. 33, 125.)

In our present state of knowledge, it is best, for the present at least, to look upon these five maladies as distinct diseases, in the same sense that human and avian malaria are considered as due to distinct, though closely allied, organisms.

SURRA.

DEFINITION OF SURRA.

Surra is a specific and continuous infectious febrile disease occurring in solipeds and camels, and capable of being transmitted by inoculation to other animals. It is due to the presence of a flagellate protozoon (*Trypanosoma Evansi*) in the blood. It is chiefly met with in an epidemic form, during certain months of the year, namely, during or immediately following the wet seasons. It is characterized by an intermittent, remittent, and sometimes a relapsing, type of fever which continues for varying periods, from a few days to months, according to the species and the constitutions of the animals attacked, and presents definite symptoms following one another in regular sequence. The chief symptoms, in addition to the fever, are the occasional appearance of an urticarial eruption, general or localized, closely following the first rise in temperature, but which may make its appearance at any time during the course of the disease; then the presence of petechiæ on the mucous membranes, chiefly those covering the membrana nictitans; lachrymation, and the exudation of a yellow semi-

gelatinous material into the subcutaneous and other connective tissues. There is rapid wasting and great weakness, although in the great majority of cases the appetite remains good throughout, no matter how high the fever is. There is extreme pallor of the visible mucous membranes, and this is followed at a later period by yellowness. From first to last there is progressive anemia; the blood at first presents a normal character, but after a varying period of time undergoes marked changes. The white corpuscles are increased in number, and the red corpuscles usually cease to form normal rouleaux, lose their individuality, and run together, forming irregular masses, which are at first dark, but gradually, as the disease advances, almost entirely lose their coloring matter and become pale.

The presence of the flagellate is not continuous during the whole course of the disease. At first it is usually found in small numbers in the blood, and increases with greater or less rapidity until, having attained a maximum, it disappears either gradually or suddenly, to reappear after an interval. The periods during which it is present in and absent from the blood are marked by extreme irregularity, varying from 1 to 6 days, but the latter number is very unusual.

The disease is invariably fatal, death being generally due to exhaustion, but sometimes to concurrent complications. After death no specific lesion is present, but as a rule there are small subpleural and subendocardial extravasations, together with enlargement of the liver and spleen, and if death takes place during the paroxysm the hematozoon will be found for a certain time in the blood. (Lingard, 1893, pp. 1–2.)

GEOGRAPHICAL RANGE OF SURRA.

According to Lingard (1899, pp. 1–2), the geographical range of this disease is much wider than was once imagined:

"Among the first recognized districts in India were Dera Ismail Khán, on the northwestern frontier, east of the Indus, where the disease has been known for generations, Asni near Rájanpur, Kohat, Upper Burmah, the Island of Bombay, Konkan, Meerut in the Northwest Provinces, in the Berárs, and in Cachar and Assam. It was also reported from the Persian Gulf, Persia, and Tonquin. There were also strong reasons for believing that animals have succumbed to this disease in Abyssinia, the Zambesi, East Africa, Australia, North America, Brazil, and Southern Europe.

"Since the publication of the above report numerous fresh centers have been brought to light. Out of the 31 districts in the Punjab, surra has been found up to the present to be enzootic in 22, the worst being the Karnal district. In the Northwest provinces the disease has been observed in the Saharanpur, Muzzafarnagar, Meerut, Bulandshahar, Gaziabad, and Fyzabad districts; in the northeast portion of the Jalpaiguri district, Bengal. In addition widespread outbreaks have occurred in the Ahmedabad, Baroda, and neighboring localities, which have carried off thousands of equines. Spontaneous cases of surra have also been recognized in Lower Burmah, Rájputana, and Bikanir. One horse also arrived in Bombay from the Persian Gulf suffering from surra.

"In other parts of the world the *Trypanosoma* has been reported from Algeria (equines), France (bovines), Korea (equines and bovines), Egypt and Syria (equines), while in Zululand a *Trypanosoma* has been observed in the blood of equines, ovines, and canines, which is indistinguishable microscopically from the flagellated protozoon found in the circulation of animals in India."

We are not familiar with the data which led Lingard to indicate that animals have succumbed to surra in North America, but it does not seem impossible that a confusion with Texas fever has arisen. The references to Africa apparently refer to nagana, which Lingard considered identical with surra. Further, the possibility does not appear to be absolutely excluded that some other cases of alleged surra may have been erroneous diagnoses of other maladies, especially in cases where the deaths are taken from reports not based upon blood examinations

HISTORY OF SURRA.

Surra has been known in India for several generations. It was first brought to the attention of the rest of the world in a report to the government of India, written by Griffith Evans, M. D., published November 13, 1880. Since that time numerous papers on the subject have been printed, especially by physicians and veterinarians in the service of the English Government. Alfred Lingard, imperial bacteriologist in India, has been especially active in his researches, and has published a number of exceedingly valuable reports on the subject, containing numerous clinical histories, tables, analyses, etc. The other workers who have made valuable contributions to the surra literature may be seen from the references and the bibliography of the present report.

ORIGIN OF SURRA IN THE PHILIPPINES.

Our information from Manila is not yet sufficiently detailed to enable us to judge with certainty whether surra has existed many years there or whether it was recently introduced. If it has been recently introduced, it seems very possible, from our present incomplete knowledge of the exact data, that it was carried to China by the English troops from India, and that our troops carried it from China to the Philippines. This explanation is, however, purely in the line of speculative possibility, and is not in accord with the statements made by Dr. Slee (see pp. 12–13) and Dr. Kinyoun (p. 15), though from present accessible data it does not seem to be entirely established that the disease mentioned as existing in previous years was of the same nature. The point in question can be established in the Philippines better than by us here in Washington.

CLIMATIC INFLUENCES GOVERNING SURRA.

All authors agree that surra is a disease which coincides with moist conditions, occurring during or immediately following the heavy rainfalls, although it is admitted that sporadic cases may occur at other seasons of the year—for instance, those which are hottest. In the same way it is described as being influenced by floods and inundations, and as being common in the vicinity of water, as canals, rivers, etc.

Lingard (1893, p. 49) refers to 85 cases of naturally acquired surra which he compiled from the records of the Bombay Tramway stables, and shows that 84 of these, or 98.8 per cent, occurred during the months of September to December.

The following passage from Lingard (1899, pp. 73–74) bears upon this point:

RAINFALL AND SURRA.

"The question as to what conditions influence the early or late advent of surra in horses is one of especial interest and importance, both from a practical and scientific standpoint. It is only in government and private establishments, however, where careful records are collected concerning the disease, that details can be obtained from which deductions of any value can be drawn. In 1890, efforts were made in this laboratory to compile statistics with a view to determine what effect is produced on the appearance of the disease by the varying amount of rainfall in different years. At present we have obtained statistics for the past ten years with regard to the date on which the disease first made its appearance at the stables of the Bombay Tramway Company, together with the records of rainfall during the same period.

Table showing the monthly rainfall in Bombay for the years 1888–1897, with the dates of surra outbreaks, and the number of horses attacked in each surra season at the Bombay Tramway Company's stables.

MONTHLY RAINFALL.

Months.	1888.	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.
	Inches.	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
January	1.85	.....	.....	.....	.....	.....	0.22	.....	.....	0.01
February	.02	.....	.....	.....	.....	0.14	.....	0.07	.....	.....
March	.10	.....	.....	0.20	.....	.....	.06	.....	.....	.....
April	.....	.....	0.01	.....	.....	.02	.01	.....	.....	.....
May	.....	0.67	.06	.....	0.11	6.30	.....	.08	0.26	.....
June	15.76	19.89	24.55	13.99	13.30	21.47	16.87	17.84	28.02	14.40
July	22.47	30.15	21.34	32.48	23.86	16.14	26.16	18.04	36.44	30.19
August	11.43	10.32	10.61	6.94	36.56	13.57	8.40	15.97	20.77	13.82
September	4.92	2.71	6.45	22.53	18.73	7.52	12.04	11.91	1.62	20.60
October	.11	3.80	.58	1.04	1.89	.45	3.08	3.62	.01	2.51
November	1.16	.....	1.25	.....	.67	1.63	.....	.06	.53	.....
December	.....	.....	.13	.....	.....	.22	.01	.....	.....	.....
Total rainfall for year	57.82	67.84	64.98	77.18	95.12	67.46	66.85	67.59	87.65	81.53
Total rainfall from May 1 to date of outbreak of surra	54.69	61.97	63.56	66.50	84.87	39.41	44.09	52.02	85.49	81.52

Table showing the monthly rainfall in Bombay for the years 1888–1897, etc.—Continued.

OUTBREAKS OF SURRA.

Year.	Date of outbreak.	Year.	Date of outbreak.
1888	Oct. 18	1894	Aug. 11
1889	Sept. 14	1895	Sept. 2
1890	Oct. 6	1896	May 9
1891	Sept. 13		Aug. 30
1892	Sept. 12	1897	Nov. 26
1893	July 20		

NUMBER OF HORSES ATTACKED EACH YEAR.

Year.	Number attacked.	Year.	Number attacked.
1888	14	1893	11
1889	47	1894	10
1890	2	1895	17
1891	1	1896	19
1892	15	1897	3

July 20, 1893, 3 horses attacked—1 Australian, 1 Arabian, 1 Persian.
May 9, 1896, 1 case of surra, most unusual.
August 30, 1896, regular outbreak commenced.
November 26, 1897, 3 Australians at Parel stables. Flies very troublesome.
Average annual rainfall for ten years, 73.40 inches.
Average for ten years, 67.35 inches.
Average death rate from surra for ten years, 13.9.

"As will be observed on reference to the above table, the most common months for surra to appear (six times out of ten) were September and October; twice it appeared in August and once in July and November, respectively. When a rainfall of 6.3 inches fell in Bombay in May, 1893, 3 horses were attacked on the same day, namely, July 20. It was then considered that the disease might be accounted for by the hematozoon or its resting form having escaped the great heat during the month of May, and so have retained its vitality, so that its power of reproducing the disease would be increased by the earlier rainfall, and the outbreaks of surra thus occur sooner. But in 1896 a sporadic case of surra occurred among the same stud, consisting of some 700 horses, on the 9th day of May, a most unexpected occurrence, as up to that time only 1 animal (Australian, No. 65, owned by a private individual) had been observed with the disease, and that was contracted in the districts. From the 1st of the previous November until May 9, 1896, only 0.06 of an inch of rain fell, and that was in the first-mentioned month. Consequently, here we have undoubted proof, confirmed by microscopic examinations of the blood of the animal, that surra may appear in Bombay in the hottest part of the year, when no rain has fallen for 6 months. In 10 years 1 animal out of 139 attacked with surra developed the disease in the month of May, but the annual outbreak at these stables which carried away 17 horses did not occur until September, October, and November of the same year, toward the end of the monsoon season. On the other hand, it is a well-established fact that in the great majority of years during which an excess of rain falls, the most severe outbreaks of surra occur. In support of this statement the following outbreaks may be brought forward. During 1894 heavy rain fell on several successive days in September in the Ahmedabad, Baroda, and neighboring districts. Thousands of equines succumbed to surra during the October and November following, over an

area of 400 square miles; and by order of the Government the horse fair at Ahmedabad was abandoned for a period of 2 years.

"Again, on the Saharanpur-Mussoorie dâk line, 77 animals died of surra, at stations in the Mohand Pass, during the rains of 1894, when the rainfall was in considerable excess of the normal.

"In 1895, during the rains, which were heavy, surra caused its ravages in over 200 villages in the Karnal district, Punjab. The losses among equines in 16 villages in the above tahsil, where statistics were forthcoming, were 253 out of 556 kept, or 45.5 per cent. During the same period 53 villages in the Saharanpur district, northwest provinces, lost 909 out of a total of 1,590, or 57.1 per cent.

"Let us now consider the outbreaks which occur annually at the foot of the outer Himalayas at Kathgodâm in the Kumaon Bhabar. At my request, meteorological observations were commenced at this station in 1896, and the following table shows the information we require, but for the past 2 years only:

Table showing rainfall June 1 to October 31, in inches.

Stations.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.
Naini Tal, elevation 6,350 feet.....	123.02	81.85	63.73	126.91	105.19	85.10	63.85	114.93
Kathgodâm, elevation 1,630 feet....	.....	.....	.....	.....	.....	.....	50.71	108.52
Haldwani, elevation 1,200 feet.....	100.06	65.91	56.38	83.73	92.96	69.16	63.82	91.86
Average number of horses....	90	93	93	180	128	131	101	80
Horses died (of surra) between the Brewery and Kathgodâm.....	40	10	5	2	63	8	92	2

"In 1896, 19.4 inches of rain fell during the month of June, and at the time that the monsoon ceased somewhat abruptly in August, 50.31 inches had fallen. Surra broke out among the dâk animals in July, and 32 succumbed up to the end of August. When I visited the station on the 5th of September, the blood of 24 ponies was found to contain the organism on microscopical examination, and in 9 animals it was found within the next few days, making 33 in all. Different varieties of flies make their appearance during the fine intervals of the monsoon, and in the year in question, when the rains terminated in August, flies invaded the tonga road in very large numbers, but no examples of the *Glossina morsitans* were discovered. As the diseased animals were not destroyed, or even isolated, we have not far to seek for the cause of the terrible mortality among the tonga ponies. In the following year (1897), the rains only commenced on the 12th of July, but continued until the month of October, a total of 108.52 inches falling. During the last-mentioned season, however, immediately a tonga animal was reported with fever, it was at once segregated, some miles away from the rest of the ponies, with the result that only 2 animals have succumbed to surra during the season. It would also appear that the lateness of the setting in of the monsoon, together with the heavy downpour when it set in, and want of sunlight and warmth, also contributed and brought about conditions unfavorable for the development of the *Trypanosoma* and flies in general.

"With regard to surra in other than tonga ponies, it is no good the railway company going to great trouble and expense in order to provide boiled water, grass from an elevation of 6,000 feet, clean corn, prohibiting the use of green vegetation during the rainy season, and segregating all their sick animals, if small private owners of ekka and riding ponies, etc., are allowed to keep their diseased animals in sheds or wandering about unattended within a few yards of the company's stables or are allowed to ply for hire along the same narrow road. It stands to reason that the myriads of flies which abound and infest all animals at these seasons have only to carry the

contagion a distance of a few yards from the diseased to the healthy animals. In order to save expense and trouble, the native owners, on recognizing that their tats are suffering from a fatal disease, turn them loose to shift for themselves; consequently they become a source of danger to every healthy animal in the neighborhood during life, and a disagreeable stimulus to the olfactory organs of passers-by for a varying period after death."

The explanation that the hematozoon would have its power of reproducing increased by rainfall should, perhaps, be accepted with some reserve. At least, another explanation occurs to us which seems more in accordance with analogy. In dry weather biting flies are not so active as in moist weather, and flies which are in a pupal stage are not so likely to issue. When a rain comes, however, flies issue from the pupæ in the dry ground and proceed to breed rapidly. Thus, during and following rainfall there would be more biting insects flying, hence there would be a greater chance for spreading the malady. (See pp. 21 47.)

RESIDENCE IN INFECTED COUNTRY.

Of 80 cases compiled by Lingard (1893, p. 49), 16.25 per cent occurred in animals which had been in the country for varying periods of less than 1 year; 76.25 per cent succumbed within the first 7 of the 14 years under observation.

INFLUENCE OF SEX, AGE, AND BREED.

According to Lingard (1893, pp. 47–48), sex plays no rôle in reference to surra; both mares and horses are affected. Of 85 animals referred to, 45.8 per cent were between 5 and 9 years old. Of these same animals, 80 per cent were Australians, and the statistics of the Bombay Tramway Company show that Australian horses are much more subject to the disease than are the Asiatics. White and gray mules are said to be more susceptible than darker animals.

SPECIES OF ANIMALS SUBJECT TO SURRA.

Surra is found especially in horses, asses, and mules, but is not confined to these species. Outbreaks of the disease are reported also for camels, elephants, cats, and dogs, and the disease has been transmitted by inoculation to cattle, buffaloes, sheep, goats, rabbits, guinea pigs, rats (*Mus decumanus*, *Nesokia providens*), and monkeys. The limits of its infectivity are not yet established, and on this account all mammals must, for the present, be considered as *possible* carriers of the malady until negative experiments prove them to be refractory. No birds, reptiles, amphibia, or fish are known to harbor the parasite (*Trypanosoma Evansi*).

PARTIAL LIST OF OUTBREAKS.

From the high mortality of surra, it may be seen that this disease is exceedingly important from both an economic and a military standpoint. In order to give an idea of the losses which have occurred, the following partial list of the outbreaks, compiled by Dr. Albert Hassall, is here appended:

1878.

PUNJAB.

Griffith Evans, 1881, p. 2: Fourth Punjab Cavalry lost 40 horses.

1879.

Griffith Evans, 1881, p. 2: Fourth Punjab Cavalry lost 118 horses.

1880 (to September).

Griffith Evans, 1881, p. 2: Fourth Punjab Cavalry lost 114 horses.

Before 1881.

ARSENE.

Griffith Evans, 1881, p. 2: Third Punjab Cavalry lost 350 horses from surra a few years ago.

1885.

HUNG-HOA.

Blanchard, 1888: Many mules in Twelfth Regiment Artillery died of an affection designated at Tonkin under the name anémie palustre, fièvre ou cachexie palustre.

Before 1887.

Burke, 1891, p. 270: Bengal Cavalry, 180 horses died.

Before 1890.

KATGODAM, NORTHWEST PROVINCES.

Lingard, 1894a, p. 1: Many tonga ponies (principally cabulis) succumbed to surra.

1890.

FAZILKA TEHSIL, FEROZEPUR DISTRICT.

Lingard, 1898a, p. 8: Lost a few animals.

KATGODAM, NORTHWEST PROVINCES.

Lingard, 1894a, p. 1: 40 ponies also died.

MANIPUR.

Lingard, 1895, p. 1: 80 out of 230 equines died. Elephants unaffected.

1891–1893.

KATGODAM, NORTHWEST PROVINCES.

Lingard, 1894a, p. 1: 15 ponies died between 1891–1893.

1891–1894.

SHUTRA-KHÁNA STUD AND GANGU RISALD.

Lingard, 1895, p. 2: 740 camels have died of surra.

1892.

WAZIRABAD TEHSIL, GUJRANWALA DISTRICT.

Lingard, 1898a, p. 8: 5 horses and 10 asses.

1892–1896.

SONEPUT TEHSIL, DELHI DISTRICT.

Lingard, 1898a, p. 10: 48 horses, 38 mules, and 8 asses died.

1893.

BOMBAY.

Lingard, 1894a, p. 1: A horse arrived in the port of Bombay from the Persian Gulf suffering from surra.

BURMAH.

Lingard, 1894a, p. 1: The Kachnis lost 14 elephants from the disease, out of a total of 32.

CHINDWIN.

Lingard, 1895, p. 2: Bombay-Burmah Company lost 24 elephants, valued at 45,000 rs.

SÁHÁRÁNPORE AND MUSSOORIE.

Lingard, 1894a, p. 1: Outbreak occurred in the stables of the dâk ponies.

SECUNDERABAD.

Lingard, 1895, p. 1: First Madras Lancers lost 49 country-bred horses.

WAZIRABAD TEHSIL, GUJRANWALA DISTRICT.

Lingard, 1898a, p. 8: 3 horses and 5 asses.

1893–1894.

GÁIKWÁRI DISTRICT.

Lingard, 1895, p. 1: A large number of horses and donkeys died all over the district.

MUSSOURIE ROAD, BETWEEN SAHARANPUR AND RÁJPUR.

Lingard, 1895, p. 1: Owners of dâk ponies lost 146 animals from surra.

1893–1895.

WAZIRABAD TEHSIL, GUJRANWALA DISTRICT.

Lingard, 1898a, p. 8: Several horses and mules died, being equivalent to 45 per cent of the animals possessed.

1893–1896.

FEROZEPUR TEHSIL, FEROZEPUR DISTRICT.

Lingard, 1898a, p. 8: 17 villages affected.

1894.

AJNALA TEHSIL, AMRITSAR DISTRICT.

Lingard, 1898a, p. 9: Lost 62 horses, 34 asses, 1 mule—92 per cent of horses, 40 per cent of asses, and 100 per cent of mules.

AURANGPUR, NANGALA, AND DADRI.

Lingard, 1895, p. 2: 15 ponies died.

BAREILLY.

Lingard, 1895, p. 1: One outbreak occurred, in which all animals affected were either killed or died of the disease.

BAREILLY AND RÁNIKHET.

Lingard, 1895, p. 1: Government commissariat department lost 100 mules in October.

Lingard, 1895, p. 1: Bombay mounted police lost 11 horses.

GUJRANWALA TEHSIL, GUJRANWALA DISTRICT.

Lingard, 1898a, p. 8: 23 horses and 21 asses died.

JAGADHERI TEHSIL, UMBALLA DISTRICT.

Lingard, 1898a, p. 9: 17 asses died — 76 per cent.

KATGODAM–NAINI TAL TONGA SERVICE.
Lingard, 1895, p. 1: Lost 67 animals out of 128.
PÁLI.
Lingard, 1895, p. 1: 50 brood mares and young stock belonging to Mahárájah Sir Pertáb Singh died.

1894–1895.

DELHI.
Lingard, 1895, p. 2: An outbreak occurred among cavalry horses.
GUJERÁT, AHMEDABAD, BARODA, ETC.
Lingard, 1895, p. 1: A very severe and widespread outbreak involving an area of 400 square miles.
HOSHIARPUR DISTRICT.
Lingard, 1898a, p. 9: 61 horses and 32 asses died—82 per cent of horses and 64 per cent of asses.
LAHORE TEHSIL, LAHORE DISTRICT.
Lingard, 1898a, p. 8: 24 horses and 22 asses died.
PANIPAT TEHSIL, KARNAL DISTRICT.
Lingard, 1898a, p. 9: 28 horses died.

1895.

CHUNIAN TEHSIL, LAHORE DISTRICT.
Lingard, 1898a, p. 8: 12 horses died.
JAGADHERI TEHSIL, UMBALLA DISTRICT.
Lingard, 1898a, p. 9: 80 per cent of horses, 100 per cent of asses and mules died.
JAGRAON TEHSIL, LUDHIANA DISTRICT.
Lingard, 1898a, p. 9: In the village of Man 42 camels died.
KARNAL TEHSIL, KARNAL DISTRICT.
Lingard, 1898a, p. 9: 24 horses, 20 asses, and 15 mules.
KHANGAH TEHSIL, GUJRANWALA DISTRICT.
Lingard, 1898a, p. 8: 2 asses only.
LODHRIAN TEHSIL, MOOLTAN DISTRICT.
Lingard, 1898a, p. 8: 24 horses died—64 per cent.
MUKTSAR TEHSIL, FEROZEPUR DISTRICT.
Lingard, 1898a, p. 8: 8 horses died.
NAWASHAHAR TEHSIL (July to August).
Lingard, 1899, p. 9: In two villages, 8 horses and 20 asses died out of 21 and 27 animals, respectively.
PESHAWAR TEHSIL, PESHAWA DISTRICT.
Lingard, 1898a, p. 8: 3 horses died—16 per cent of the animals.
PIPLI TEHSIL, UMBALLA DISTRICT.
Lingard, 1898a, p. 9: Surra occurred in Radour, but losses were not heavy.
UMBALLA TEHSIL, UMBALLA DISTRICT.
Lingard, 1898a, p. 9: 25 asses died—20 per cent.

1895–1896.

JAGRAON TEHSIL, LUDHIANA DISTRICT.
Lingard, 1898a, p. 9: 38 horses and 14 asses died.
KAITHAL TEHSIL, KARNAL DISTRICT.
Lingard, 1898a, p. 9: 9 horses and 71 asses died.

1896.

BURMAH.
Lingard, 1898a, pp. 12–16: Vet. Capt. George H. Evans reports an outbreak among military and police ponies at Mandalay, and records 2 deaths from surra and 14 killed on account of the disease; also 22 mules destroyed.

KATGODAM, NAINI TAL DISTRICT.
Lingard, 1898a, p. 10: 32 horses died between July 1 and September 4.
KHANGAH TEHSIL, GUJRANWALA DISTRICT.
Lingard, 1898a, p. 8: 9 villages suffered loss from surra; 1 animal died in March, the others (?) during August, September, and October.
PIND DADAN KHAN TEHSIL, JHELUM DISTRICT.
Lingard, 1898a, p. 8: 5 animals died.
PIPLI TEHSIL, UMBALLA DISTRICT.
Lingard, 1898a, p. 9: "Chibha" suffered somewhat from the disease.

1896–1897.

BOMBAY. BOMBAY PRESIDENCY.
Lingard, 1898a, p. 11: 20 horses died.
GURDASPUR DISTRICT.
Lingard, 1898a, p. 9: Losses very small.
JABBALPUR, CENTRAL PROVINCES.
Lingard, 1898a, p. 11: 23 horses in all died of surra up to February 17, 1897.

LETHALITY OF SURRA.

Nearly all authors agree that surra in equines and camels is "invariably fatal." Thus, Griffith Evans (1881, p. 3) says that weak animals succumb soonest; (p. 7) records of the Fourth Punjab Cavalry show that no cases on the sick list ever recover; a few cases are said to have made slow progress in the disease, alternately better and worse for over a year; but they all eventually succumbed. Burke (1888a, p. 9) refers to surra as "extremely fatal," and (p. 85) quotes Steel as describing it as "invariably fatal;" later Burke (1891, p. 268) says that there is probably no disease in which the fatality is so high as in "pernicious anemia" (which he identifies with surra). Ranking (1891a, p. 399) also designates surra as "invariably fatal," and Lingard (1893, p. 79) says that surra in equines is "always fatal in the horse, mule, and camel, but in the bovine species after a period, during which the animal suffers from fever, and the infusorian is present in varying numbers in the blood, the animal generally returns to a normal state of health." (See also, 1899, pp. 80–88.) Pease (1897, p. 551) claims to have seen thousands of cases, but he never saw one recover spontaneously; "surra is invariably fatal;" (p. 556) in camels it runs a slow course, nevertheless, in the end the camel dies of surra, sometimes after so long a period as two or even three years; he (pp. 557–558) has seen all the dogs of a village swept off by this malady after eating surra carcasses. Cats also take the disease in the same way. Hayes (1898, p. 481) agrees that surra is "invariably fatal" unless treated with arsenic. Burke (1897, p. 192), on the other hand, states that if surra is treated with quinine, arsenic, iron, and other tonics, by changing the water and making some variation in the location of the animals, great benefit and even absolute removal of the disease may be secured.

(See also "Treatment," p. 91.)

IMMUNITY TO SURRA.

In 1893, Lingard (p. 7) stated that death follows the first attack in all the animals discussed, with the exception of the bovine species, and that his experiments tended to prove that one attack may grant immunity to this animal, at all events for a considerable period. It was later shown by Lingard (1895, p. 7) and others that one attack does not render an animal immune. He gives the following case:

"An Australian gelding, the subject of surra in December, 1893, was cured of this disease by the administration of arsenic and iodide of arsenic and mercury.

"Between March and October, 1894, the animal gained 235.75 pounds in weight, and was in a perfect state of health and condition. Fifteen months after the date of the previous attack, and 12 months after the cure was effected, the animal was inoculated with a minute drop of surra blood—a mere trace of soiled blood being smeared over a scratch on the muzzle—in order to ascertain whether any immunity had been conferred by the previous attack. The latent period of the second attack occupied 7 days. The progress of the disease was marked, as usual, by paroxysms of fever and intermissions, the former occupying a much more prolonged period (22 days), and the latter being shorter than usual (only 2 days).

"Death took place on the fifty-third day of the disease, clearly proving that one attack of surra is unable to protect against a second attack."

Quite recently, Lingard (1901, p. 3) states that he has worked out a serum which has been found to possess immunizing power, but difficulty has been experienced in preserving its destructive power for any length of time. He does not state how this serum is obtained, but says that his experiments will be continued.

CAUSE OF SURRA.

Zoological position of the parasite Trypanosoma Evansi.

The parasite in question belongs to the Protozoa, class Mastigophora, subclass Flagellata, order Monadida, family Trypanosomidæ, genus *Trypanosoma*, species *Trypanosoma Evansi*. The characters of these groups may be seen from the following diagnoses and keys:

Class Mastigophora Bütschli.

Class diagnosis.—Protozoa: Microscopic organisms, whose bodies usually have a definite form but are not always provided with a cell membrane; cilia are absent, but the adult stage possesses one or several flagella; mouth present or absent; usually only one nucleus present, but never a paranucleus, and usually one or several pulsating vacuoles; reproduction by division, with or without conjugation and encystation.

The systematic position and the limits of this class are debatable questions. They may be placed under the rhizopods or near the ciliates. Some of the forms which certain authors admit to the class as animals other authors place among the plants. Some forms described or identified as flagellates may perhaps be only developmental stages in the life cycle of other animals. Flagellate stages

occur, for instance, in the life cycle of some of the Mycetozoa and Sporozoa. Some of the flagellates described as parasitic are considered by certain authors as pathogenic, by other authors as harmless messmates. Quite a number of generic names have been used to designate the forms reported for man, but many of them will undoubtedly fall as synonyms. Numerous species are likely to be swallowed in drinking water. Under existing circumstances, the physician will do well to exercise considerable reserve in dealing with flagellated organisms; otherwise he may be led to erroneous conclusions.

In general, but especially in reference to the lower forms, it may be said that the protoplasm is quite homogeneous; a nearly fluid endoplasm may be recognized surrounded by a peripheral ectoplasm, the latter in turn may be bounded by a more dense layer, like a delicate cell membrane. These three divisions are, however, not always very distinct, but grade almost imperceptibly into one another. The pharynx is a very superficial infundibulum; a permanent anus appears to be absent, but the excreta appear to be expelled from a less resistant point at the posterior extremity, without, however, leaving any trace of their passage. The flagellum represents an organ of locomotion, and there may be one or more present. The pulsating vacuole is near the surface, but does not appear to possess either a distinct membrane or a permanent pore. The nucleus is rounded and appears to be provided with a nuclear membrane and a nucleolus. If conditions become unfavorable, as when the medium becomes too condensed by evaporation or too toxic by extreme putrefaction, the flagellate may discard its flagellum, become round, and form a surrounding cyst membrane; upon return of favorable conditions, it may escape from the cyst and, forming a new flagellum, recommence its active life; or it may divide during the encystment. The division of the free form in multiplying is usually longitudinal. In some cases, the organism encysts before dividing, then by longitudinal division two organisms are formed; the latter may then escape, form their flagella, and become active; or each daughter organism may reencyst and divide further; or the mother flagellate, when encysted, may divide into a large number of so-called "spores," each of which, upon escaping, forms its flagellum. There may also be a complete conjugation of two individuals, followed by encystment and division into numerous young.

It should be further remarked that, while some species are exceedingly simple in structure, as described above, other species are much more complicated and give rise to more or less complex colonies. For these forms, which have not yet been shown to have any particular medical bearing, the reader is referred to the writings of Kent, Bütschli, Delage, Calkins, and others.

Authors are not united upon the subdivisions of this class. Some writers admit three subclasses, others admit four, still others admit

five. The following key will aid in determining at least three subclasses which are recognized by most authors:

KEY TO THE SUBCLASSES OF THE MASTIGOPHORA.

1. Protoplasm of body not reticulate 2
   Protoplasm reticulate or branched; one flagellum (feeler) present; a firm membrane present; marine organisms of considerable size.....Cystoflagellata.
2. Shell usually has two grooves or furrows, one running around the body, the other longitudinally; marine and fresh-water forms.....Dinoflagellata.
   The grooves or furrows are absent .....Flagellata.

SUBCLASS FLAGELLATA.

SUBCLASS DIAGNOSIS.—Mastigophora: Small organisms, usually with a sharply defined, mononucleate body, with a definite anterior end bearing one or more flagella; actively motile during life, but possessing power of encystment; reproduction by longitudinal division, in free or encysted stage.

The Flagellata represent the only subclass of Mastigophora which at present comes into consideration as parasites. Owing to the minuteness of the objects, hence the difficulty of recognizing characters for classification, there is a wide difference of opinion among authors relative to the subdivision of the subclass into orders, families, genera, and species.

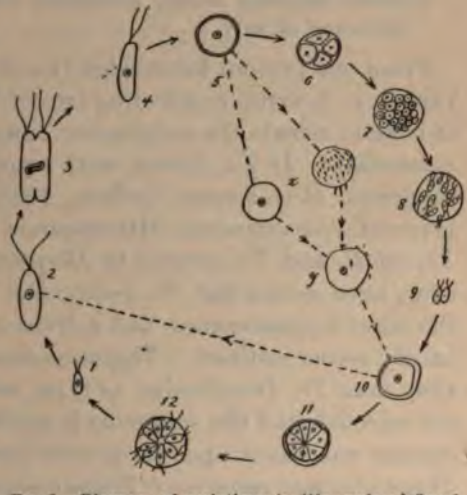

FIG. 1.—Diagram of variations in life cycle of flagellates: 1, a young flagellate; 2, adult flagellate; 3, longitudinal division of adult free form; 4, daughter flagellate; 5, encystation; 6-8, division into isogametes; *x*, division into macrogametes and microgametes, characteristic for some forms; 9, conjugation of the isogametes; *y*, conjugation of the micro- and macro-gametes; 10, resting stage—zygote; 11-12, division into young. (After Doflein, 1901, p. 53, fig. 29.)

ORDER MONADIDA.

ORDINAL DIAGNOSIS.—Flagellata: Independently living organisms, but in some cases forming colonies; arrangement of the flagella varies: 1 flagellum, usually anterior, or 2 equal flagella, or 2 unequal flagella, or 1 large and 2 small flagella; undulating membrane may be present.

FAMILY TRYPANOSOMIDÆ DOFLEIN, 1901.

FAMILY DIAGNOSIS.—Flagellata: Parasitic forms with one chief flagellum directed anteriorly; in some forms a secondary flagellum directed posteriorly; body usually with two angles, and wound more or less in the form of a spiral; one angle of body provided with an undulating membrane. One nucleus and one centrosome present.

TYPE GENUS.—*Trypanosoma.*

The family at present contains two genera, which are distinguished as follows:

One flagellum present, extending from the centrosome along the undulating membrane and becoming free at the anterior extremity.....*Trypanosoma*, p. 32.

Two flagella, one extending anteriorly, the other posteriorly..*Trypanoplasma*, p. 42.

Genus Trypanosoma[a] *Gruby, 1843.*

GENERIC DIAGNOSIS.—Trypanosomidæ: Body fusiform, presenting a lateral longitudinal undulating membrane, the thickened border of which terminates posteriorly, in the posterior half of the body, in a "centrosome," and is prolonged anteriorly in a free major flagellum; nucleus generally anterior; there is a tendency to agglomeration by the posterior extremity; division longitudinal and unequal. Parasitic in blood of vertebrates.

TYPE SPECIES.—*Trypanosoma rotatorium.*

Doflein divides this genus into three subgenera, as follows:

1. Major flagellum present ..... 2.
   Major flagellum absent, or very short and thick ..... *Trypanosoma.*
2. Undulating membrane continued posteriorly in a flagellum, so that 2 flagella are present ..... *Trypanomonas.*
   Posterior flagellum absent, undulating membrane ending on or before end of body ..... *Herpetosoma.*

From our present knowledge this division is not free from objection. Doflein is in error in selecting two of his names: *Trypanosoma* would, of course, remain the subgeneric name for the group containing *Tr. rotatorium.* If *Tr. Evansi* were recognized as belonging to a distinct subgenus, *Herpetosoma* Doflein, 1893, would have to be rejected in favor of *Hæmatomonas* Mitrophanow, 1883, as Doflein includes both *Tr. cobitis* and *Tr. carassii* in *Herpetosoma.* Laveran & Mesnil, however, have shown that *Tr. rotatorium* presents the same characters as the other trypanosomes, and a division of these forms into subgenera hardly seems justified. *Trypanomonas* Danilewsky, 1885, can not possibly take *Tr. Danilevskyi* as type, unless all of Danilewsky's names are rejected, and the subgenus is attributed to Labbé, 1891. *Trypanomonas* was based upon structures interpreted as young stages named *Trypanomonas ranarum=Trypanosoma rotatorium*, hence takes this species as its type, and thus becomes a synonym of *Trypanosoma* (*Trypanosoma*). Laveran & Mesnil, 1901g, have now separated "*Trypanosoma* (*Trypanomonas*)" of Doflein as a distinct genus, *Trypanoplasma*, with *Trypanoplasma Borreli* as type species.

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[a] SYNONYMS.—Under *Amœba* Mayer, 1843 [not *Amœba* Ehrenberg]; *Trypanosoma* Gruby, 1843 (type, *Tr. sanguinis=rotatorium*); *Monas* Lieberkühn; *? Globularia* Wedl, 1850 [not Swains., 1840, mollusk]; *Undulina* Ray Lankester, 1871 (type, *U. ranarum =Trypanosoma rotatorium*); *Herpetomonas* Kent, 1880 [only in part, as the type is *H. muscæ-domesticæ*]; *Paramœcioides* Grassi, 1881 (type, *P. costatus=Trypanosoma rotatorium*); "*Tripanosoma* of Gruby" of Lanessan, 1882, and Balbiani, 1888; *Hæmatomonas* Mitrophanow, 1883 (type, *H. cobitis*); *Trypanomonas* Danilewsky, 1885 (type, *Trypanomonas ranarum=Trypanosoma rotatorium*); "*Spirochæte* of Steel, 1885" [quoted also as *Spirochetæ* and *Spirochæta*]; "*Hemotomonas*" of Blanchard, 1888; "*Trichomonas sanguinis*" of Crookshank, 1886, as "subgenus;" "*Triponomonas* Crookshank" of Balbiani, 1888, p. 399 [probably a typographic error *o* for *a*, and confusion between *Trypanomonas* Danilewsky and *Trichomonas*]; "*Trypanosomes* Gruby" of Laveran, 1895; *Trypanosomum* Chauvrat, 1896; "*Trypanosome* Gruby" of Buffard & Schneider, 1900; "*Paramœcioides* Grassi, 1882" of Laveran & Mesnil, 1901; "*Tryanosoma* Doflein, 1901," typographical error for *Trypanosoma.*

Description of Plate I.

Figs. 21–29.—Reproduction of *Trypanosoma Lewisi* in the rat. X about 2,000 diameters. (After Laveran & Mesnil, 1901e, pl. 11, figs. 1–9.)

Fig. 21.—Slender adult form.

Fig. 22.—Swollen form preparing to divide.

Fig. 23.—Division of the centrosome and of the base of the flagellum.

Fig. 24.—The division into two organisms is almost accomplished; one of the two individuals bears the old flagellum, the other a newly formed short flagellum.

Fig. 25.—Stage of multiplication with 4 elements, 3 have new flagella, the fourth bears the old flagellum.

Fig. 26.—Stage of multiplication of the nucleus and of the centrosome, not yet accompanied by the division of the protoplasm; one of the flagella is larger than the others.

Fig. 27.—Complete rose cluster of 10 small elements on the point of separating.

Fig. 28.—Free young form.

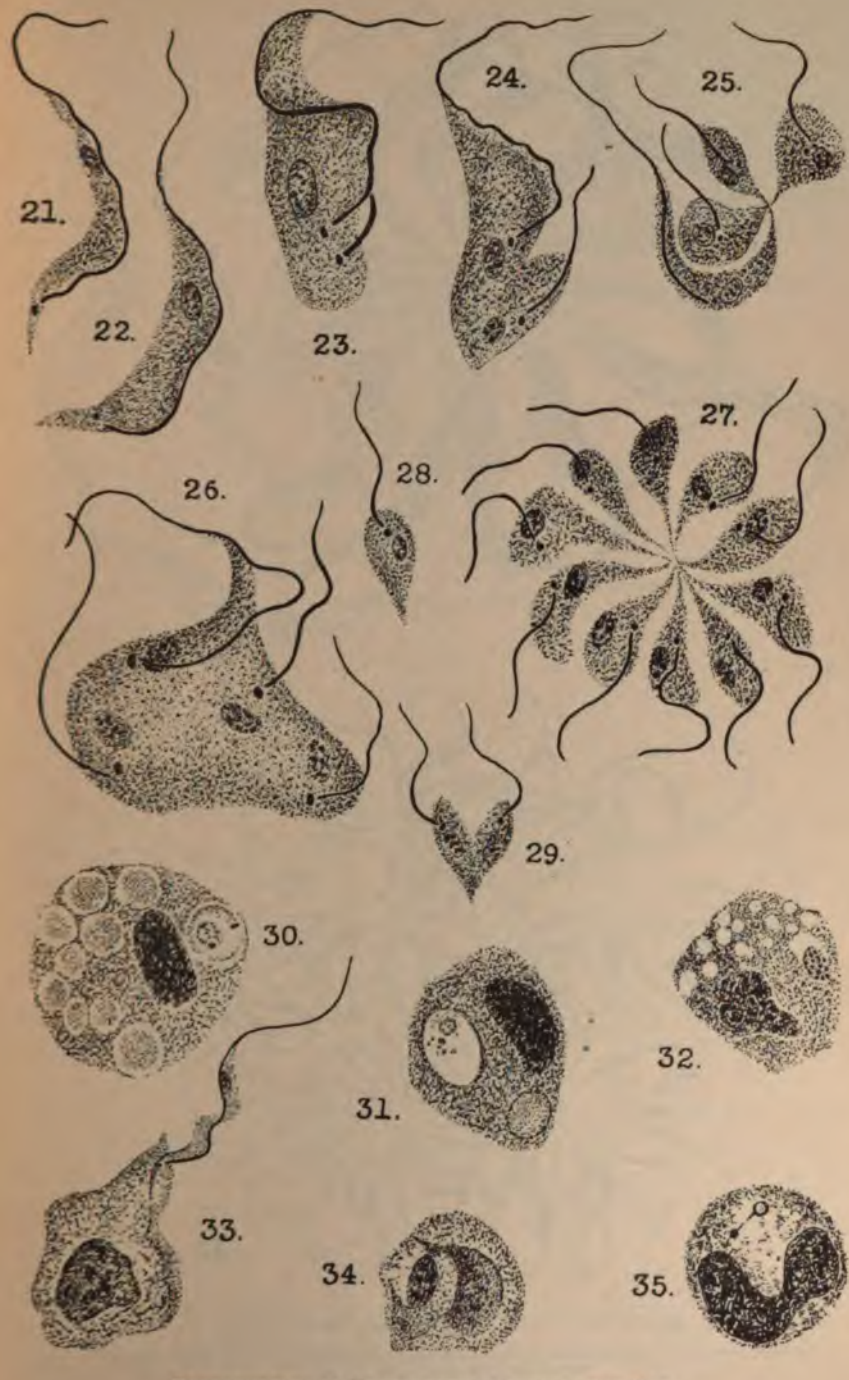
Fig. 29.—Young form in the act of dividing.

Fig. 30–35.—Ingestion of the trypanosoma by phagocytes. X about 1,100 diameters. (After Laveran & Mesnil, 1901e, pl. 11, figs. 10–15.)

Figs. 30–32.—Three phases of the digestion of trypanosoma by mononuclear leucocytes of the peritoneal exudate of a guinea pig; two of these leucocytes have also swallowed blood corpuscles.

Figs. 33–34.—Two phases of indigestion of trypanosoma by leucocytes of the peritoneal exudate of a rat having active immunity.

Fig. 35.—Chromatic mass in a leucocyte of a rat; passive immunity.



Reproduction of Trypanosoma Lewisi in the Rat.

The genus *Trypanosoma* has proved to be very important from the standpoints of comparative medicine and national economics, but its relation to human medicine is at present problematic.

Rats and frogs are the most convenient hosts from which to collect trypanosomes for study. There is quite an extensive literature on the group, the more recent articles containing both bibliographies and technique. The nomenclature, in part at least, does not appear to be firmly established. The following are the best known species:

A. TRYPANOSOMA OF MAMMALS.

Trypanosoma Lewisi* (Kent, 1880) of rat trypanosomiasis.

(Figures 2–42.)

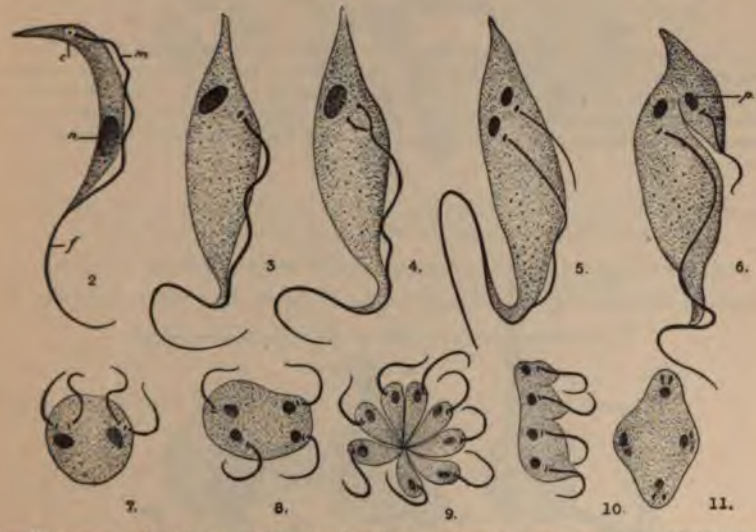


FIG. 2.—*Trypanosoma Lewisi*, completely developed; *n*, nucleus; *c*, centrosome; *m*, undulating membrane; *f*, flagellum. X about 2,000 diameters. (After Laveran & Mesnil, 1901e, p. 686, fig. 1.)

FIGS. 3–6.—*Trypanosoma Lewisi*, in process of division; fig. 6 shows a small trypanosoma on the point of separating from the mother parasite. X about 2,000 diameters. (After Laveran & Mesnil, 1901e, p. 686, figs. 2–5.)

FIGS. 7–10.—Other forms of multiplication of *Trypanosoma Lewisi*. X about 2,000 diameters. (After Laveran & Mesnil, 1901e, p. 686, figs. 6–9.)

FIG. 11.—Multiplying stage, insufficiently stained, so that the flagella are not visible. X about 2,000 diameters. (After Laveran & Mesnil, 1901e, p. 686, fig. 10.)

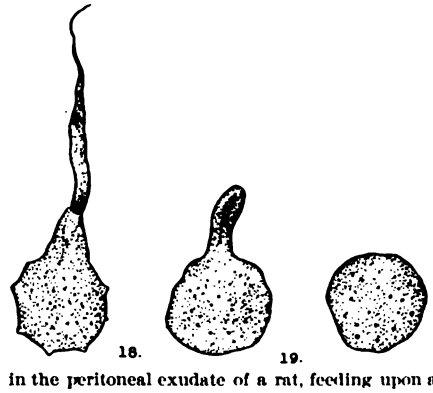
SPECIFIC DIAGNOSIS.—*Trypanosoma:* 8 to 10 μ long, 2 to 3 μ broad; 24 to 25 μ long by 1.4 μ broad (Laveran & Mesnil, 1901); a very refringent granule (near centrosome) in place of which a clear vacuole is seen in stained preparations. "Animalcules exceedingly minute, attenuate and vermicular under normal conditions, but highly polymorphic and capable of assuming a variety of contours; flagellum single,

*SYNONYMS.—*Herpetomonas Lewisi* Kent, 1880; "*Herpomonas Lewisi* (Kent)," 1880 (lapsus); *Trichomonas Lewisi* (Kent) Crookshank, 1886; *Herpetomonas Lewisii* Danilewsky, 1889; *Trypanomonas murium* Danilewsky, 1889; *Trypanomonas Lewisi* (Kent) Labbé, 1891; *Trypanosoma Lewisi* (Kent); *Trypanosoma sanguinis* Kanthack, Durham & Blandford, 1898 (not Gruby, 1843); *Trypanosoma rattorum* Börner, 1901; *Trypanosoma* (*Herpetosoma*) *Lewisi* (Kent) Doflein, 1901.

terminal, two or three times the length of the extended body; no contractile vesicle * * * as yet detected."

HABITAT.—Blood of rats (*Mus rattus*, *M. decumanus*, *M. rufescens*) and hamster

FIGS. 12-17.—Involution forms of *Trypanosoma Lewisi:* Fig. 12, trypanosoma in fresh blood of the guinea pig; fig. 13, trypanosoma in a colored preparation of guinea pig's blood; *c*, centrosome; *r*, vacuole; figs. 14, 15, trypanosomes colored after being twenty days in the refrigerator; fig. 16, deformed trypanosome, after 9 days in a hanging drop (blood and serum of chicken); fig. 17, centrosome and flagellum, in a colored preparation. (After Laveran & Mesnil, 1901e, p. 688, figs. 11-16.)



FIGS. 18-20.—Leucocyte in the peritoneal exudate of a rat, feeding upon a trypanosome, four hours after the intraperitoneal injection of trypanosomatic blood: Fig. 18, movements of trypanosome are distinct, but somewhat slower; fig. 19, five minutes later; fig. 20, five minutes still later. (After Laveran & Mesnil, 1901e, p. 706, fig. 17.)

FIGS. 39-41.—*Trypanosoma Lewisi:* Fig. 39, simple organism; fig. 40, mass resulting from division, drawn from living specimen; fig. 41, the same, from prepared specimen. (After Senn & Wasielewsky [copied from Doflein, 1901, p. 62, fig. 36].)

(*Cricetus arvalis*). Fleas, and perhaps lice also, may transmit it from animal to animal.

LITERATURE.—See especially Lingard's various papers, and Laveran & Mesnil, 1901e, pp. 673-714; Rabinowitsch & Kempner, 1899, pp. 251-294. (See also p. 125.)

There is some doubt as to whether the parasite found in the hamster is identical with that of the rat. Trypanosomes are also reported for

FIG. 42.—*Trypanosoma Lewisi* in rat's blood. "Dissolution of a rosette, with radially arranged developed young." (After Rabinowitsch & Kempner, 1899, pl. 3, fig. 27.)

other rodents (bandicoots, rabbits, spermophiles, and guinea pigs), but the descriptions are not such that they can be classified with certainty.

Trypanosoma Evansi[a] **(Steel, 1885) of surra (horses, etc.).**

(Figure 43.)

SPECIFIC DIAGNOSIS.—*Trypanosoma:* 20 to 30 μ long, 1 to 2 μ broad.

FIG. 43.—*Trypanosoma Evansi:* Two specimens are dividing. × 1,200. (After Evans, in Crookshank, 1886, p. 918, fig. 193.)

[a] SYNONYMS.—[Genus not named] *ferox* Evans, 1881 [not entitled to priority]; *Spirochæte Evansi* Steel [not accessible]; "*Spirochæta Evansi* Steel," 1885, of Crookshank, 1886; *Hæmatomonas Evansi* (Steel) Crookshank, 1886; *Trichomonas Evansi* (Steel) Crookshank, 1886; *Hæmotomonas Evansis* Blanchard, 1888; "*Trichomonas sanguinis* Crookshank" of Balbiani, 1888, p. 399, and Veterinarian, London, 1890; p. 2; "*Spirochetæ Evansii*" of Nariman & Vaz, 1893; "*Spirochæta Evansii* (Steel)" of Laveran, 1895; *Trypanosomum Evansi* (Steel) Chauvrat, 1896; *Trypanosoma Evansi* (Steel) Pease, 1897; *Trypanosoma Evansii* Pease, 1897; *Herpetomonas Lewisii* (Steel) of Danilewsky, 1889; *Trypanosoma* (*Herpetosoma*) *Evansi* (Steel) Doflein, 1901; "*Trichomonas sanguinis Evansi* Crookshank" of Doflein, 1901.

HABITAT.—Blood of horses, mules, camels, and elephants in India; transmissible to cattle, buffaloes, sheep, goats, rabbits, guinea pigs, rats, dogs, cats, and monkeys. Surra may be transmitted by flies.

Trypanosoma Brucii[a] Plimmer & Bradford, 1899, of tsetse disease (horses, etc.).

(Figures 44–49.)

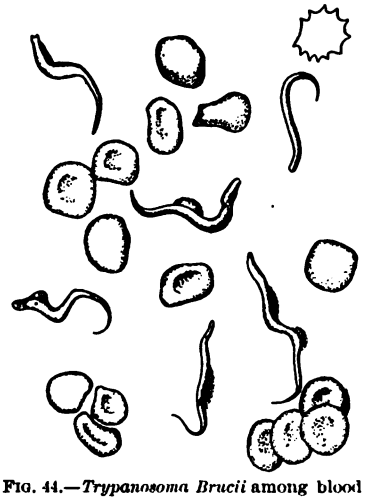


FIG. 44.—*Trypanosoma Brucii* among blood corpuscles. (After Koch, 1898, p. 66, fig. 1.)

SPECIFIC DIAGNOSIS.—*Trypanosoma:* 25 to 30 μ long, 1.5 to 2.5 μ broad. As compared with *Tr. Lewisi* the posterior extremity of *Tr. Brucii* is not so sharp, the undulating membrane is broader and more plicate, the protoplasm colors more easily and more deeply, and movements are less active. The protoplasm contains granules, which accumulate principally in anterior half, some of which are as large as the centrosome, and they color the same as the centrosome; centrosome divides before the nucleus.

HABITAT.—In blood of African horses, mules, asses, cattle, buffaloes, antelopes, camels, hyenas, and dogs; transmissible to cats, rats, mice, and rabbits, hedgehog, donkey, bosch-bok, hybrid of zebra ♂ × horse ♀, horse ♂ × zebra ♀, ass ♂ × zebra ♀, guinea pigs, goats, sheep, monkey (*Macacus rhesus*), and weasel; cause of nagana, or tsetse-fly disease, and transmitted from animal to animal by the tsetse fly (*Glossina morsitans*). (See also p. 110.)

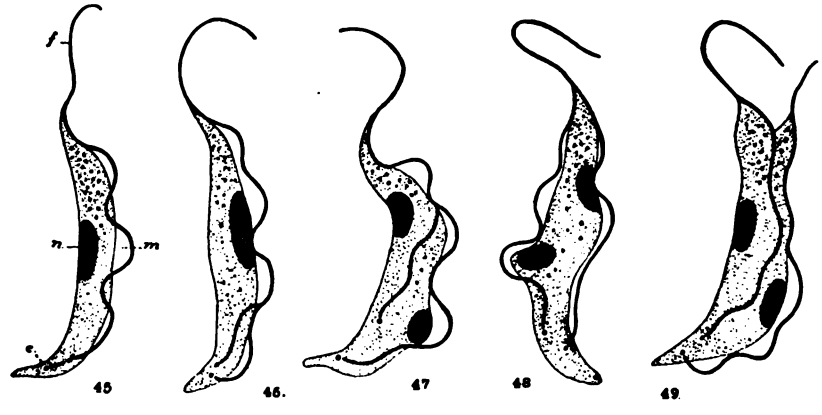


FIG. 45.—*Trypanosoma Brucii: c*, centrosome; *f*, flagellum; *m*, undulating membrane; *n*, nucleus. × about 2,000. (After Laveran & Mesnil, 1901a, p. 327, fig. 1.)

FIG. 46.—The same, beginning to divide; two centrosomes are present, and the flagellum is now dividing. (After Laveran & Mesnil, 1901a, p. 327, fig. 2.)

FIGS. 47–49.—Further stages of division. (After Laveran & Mesnil, 1901a, p. 327, figs. 3–5.)

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[a]SYNONYMS.—*Trypanosoma Brucii* Plimmer & Bradford, 1899; "*Trypanosoma Brucei*" of Schneider & Buffard, 1900; *Trypanosoma* (*Herpetosoma*) *Brucei* Plimmer & Bradford, of Doflein, 1901, p. 64; *Herpetomonas Brucei* (Plimmer & Bradford) Laveran & Mesnil, 1901.

Trypanosoma equiperdum[a] Doflein, 1901, of dourine (horses, etc.).

(Figures 50–51.)

SPECIFIC DIAGNOSIS.—*Trypanosoma:* 18 to 26 μ long, 2 to 2.5 μ broad.

HABITAT.—Blood of horse and ass, and transmissible to dogs, rabbits, rats, and white mice. Considered the cause of dourine (maladie du coït; Beschälkrankheit),

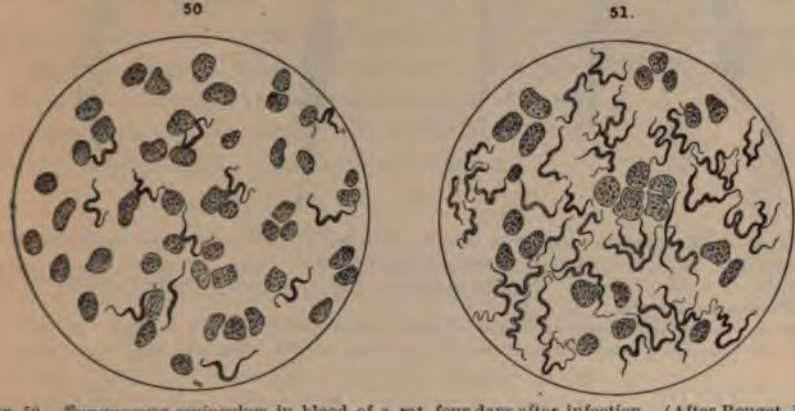

FIG. 50.—*Trypanosoma equiperdum* in blood of a rat, four days after infection. (After Rouget, 1896, p. 722, fig. 2.) FIG. 51.—The same, eight days after infection. (After Rouget, 1896, p. 722, fig. 3.)

and transmissible by coitus; Algiers, France, and Spain. Nocard believes dourine is identical with surra and nagana, and doubts exist in the minds of some observers whether *Tr. equiperdum* is actually the cause of the disease.

Trypanosoma equinum[b] Voges, 1901, of mal de caderas (horses, etc.).

(Figure 52.)

FIG. 52.—*Trypanosoma equinum.* (After Elmassian, 1901, p. 604.)

SPECIFIC DIAGNOSIS.—*Trypanosoma:* Length 3 to 4 times the diameter of a red corpuscle.

HABITAT.—Blood of horses, mules, asses, hogs, and water hogs; transmissible to white and gray rats and mice, rabbits, guinea pigs (rarely), dogs, goats, sheep, chickens, turkeys, ducks, monkeys (*Nyctipithecus felinus*), and other animals; South America.

Trypanosoma sp. of man.

Nepveu (1898) has reported the presence of *Trypanosoma* in man, but satisfactory details are lacking, and the British Medical Journal of January 4, 1902, publishes a short telegram from West Africa, reading: "*Trypanosoma*, European, peculiar symptoms. Dutton." Additional details of Dutton's case are reported in the British Medical Journal, January 11. Further than these three references, we are not acquainted with any original reports relative to trypanosomiasis in man.

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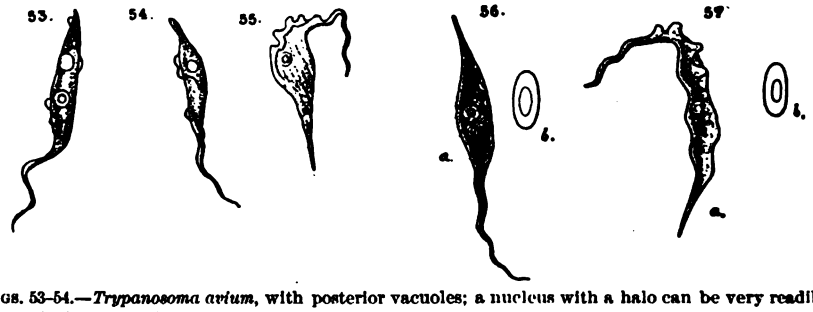
[a] SYNONYMS.—*Trypanosoma* (*Herpetosoma*) *equiperdum* Doflein, 1901, July 1; "*Tryanosoma*" (*Herpetosoma*) *equiperdum* Doflein, 1901 [misprint]; *Trypanosoma Rougeti* Laveran & Mesnil, 1901, July; *Trypanosoma* (*Hæmatomonas*) *equiperdum* Doflein of Lühe, 1902.

[b] SYNONYMS.—*Trypanosoma equina* Voges, 1901; *Trypanosoma equinum* Voges of Railliet, 1901.

B. TRYPANOSOMA OF BIRDS.

Trypanosoma avium Danilewsky, 1885, of avian trypanosomiasis.

(Figures 53–64.)



FIGS. 53–54.—*Trypanosoma avium*, with posterior vacuoles; a nucleus with a halo can be very readily seen in fig. 53. (After Danilewsky, 1889a, pl. 2, figs. 32–33.)

FIG. 55.—A more rare form of *Trypanosoma avium* (with a pectinate surface—*Tr. costatum*). (After Danilewsky, 1889a, pl. 2, fig. 34.)

FIG. 56.—Large *Trypanosoma* (*Tr. major*). (After Danilewsky, 1889a, pl. 2, fig. 36.)

FIG. 57.—The same; entire body undulated. (After Danilewsky, 1889a, pl. 2, fig. 37.)

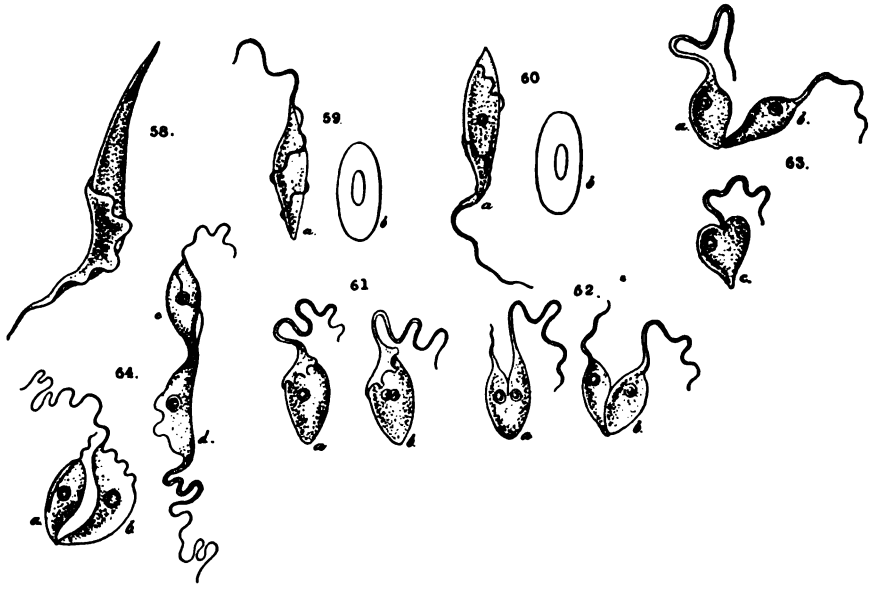


FIG. 58.—Large *Trypanosoma* (*Tr. major*), dead.

FIGS. 59–60.—Ordinary forms of *Trypanosoma avium*. (After Danilewsky, 1889, pl. 2, figs. 39–40.)

FIG. 61.—Fusiforme *Trypanosoma* of birds, before longitudinal division; the characteristic curves of the flagellum; *a*, retraction of the undulating membrane; *b*, division of the nucleus. (After Danilewsky, 1889, pl. 2, fig. 44.)

FIG. 62.—Continuation of 61; division in *a* and *b*; in *a* is formed a new flagellum which elongates rapidly. (After Danilewsky, 1889, pl. 2, fig. 45.)

FIG. 63.—Continuation of 62; division *a* and *b* almost complete; in *a* the mobile flagellum forms characteristic curves, which indicates that the division of the part (*a*) itself is about to take place; *c*, *a*, after the separation of *b*. (After Danilewsky, 1889, pl. 2, fig. 46.)

FIG. 64.—*a*, *b*, Specimens of two young *Trypanosoma avium* after longitudinal division; *a*, a thin hyaline border (which will undulate later), and a young flagellum; *b*, *a*, already an undulating mobile membrane; the undulations start from the root of the flagellum; *c*, *d*, the same *Trypanosoma*, only more developed. (After Danilewsky, 1889, pl. 3, fig. 69.)

SYNONYMS.—*Trypanosoma avium* Danilewsky, 1885; *Trypanosoma fusiforme* Dani-

SPECIFIC DIAGNOSIS.—*Trypanosoma:* 18 to 60 μ long; body cylindrical, compact, fusiform, and homogeneous; anterior extremity gradually attenuate, and continuing directly into a long or short flagellum; flagellum intimately united with undulating membrane, which extends from flagellum to posterior extremity; nucleus spherical in equator or anterior half of body.

HABITAT.—Blood of birds.

Danilewsky's use of technical names is so confusing and without system that it is often difficult to interpret his writings. Strictly speaking, he does not follow the Linnæan system, and it would perhaps be allowable, under the Code of Nomenclature, to ignore all of his technical names.

? Trypanosoma Eberthi Kent,[a] 1880.

(Figure 65.)

DIAGNOSIS.—*Trypanosoma:* "Body flattened, and semilunate when at rest, its convex membraniform border serrated or presenting a beaded aspect; straight, lanceolate, and pointed at each extremity when in motion, not produced at either end into a tag-like prolongation; the membranous border often spirally convolute around the thicker central portion, the entire body assuming under such conditions an auger-like aspect. Length 1–1760″." (Kent, 1880, pp. 219–220.)

HABITAT.—Cecum and ileum of chickens, ducks, geese, and ? pigeons.

FIG. 65.—*Trypanosoma Eberthi.* (After Eberth [original not accessible, figure copied from Doflein, 1901, p. 59, fig. 33].)

As the genus *Trypanosoma* is composed chiefly of parasites which live in the blood, doubts arise in our minds as to whether this species is correctly classified.

C. TRYPANOSOMA OF AMPHIBIA.

Trypanosoma rotatorium[b] (Mayer, 1843) Laveran & Mesnil, 1901.

(Figures 66–70.)

SPECIFIC DIAGNOSIS.—*Trypanosoma:* 40 to 80 μ long by 5 to 10 μ broad; flagellum 10 to 12 μ. "Body compressed, semilunate, twisted; the convex border membranous and undulating; the posterior extremity of the body portion pointed and curved inward, the opposite one produced into a long tag- or tail-like appendage

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lewsky, 1889; *Trypanosoma minus* Danilewsky, 1889; *Trypanosoma majus* Danilewsky, 1889; *Trypanosoma sanguinis avium* Danilewsky, 1889; *Trypanosoma costatum* Danilewsky, 1889, at least in part; *Trypanosoma major* Danilewsky, 1889.

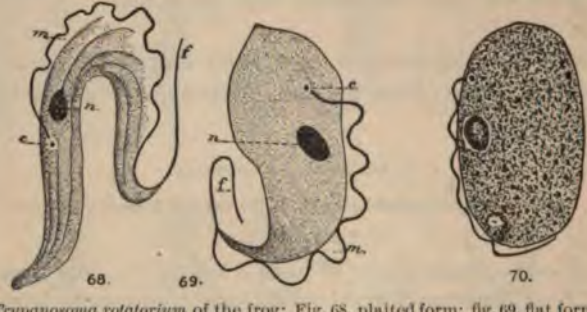
[a] SYNONYMS.—*Trypanosoma Eberthi* Kent, 1880; "*Tripanosoma Eberthi*" of Lanessan, 1882; *? Cercomonas gallinarum* Davaine, 1877; *? Cercomonas gallinæ* Rivolta, 1880; *Tripanosoma Eberthie* of Leclerq, 1890; *? Trichomonas columbarum* Kruse, 1896.

[b] SYNONYMS.—*Amœba rotatoria* Mayer, 1843, July; *Paramœcium loricatum* Mayer, 1843, July; *Paramœcium costatum* Mayer, 1843, July; *Trypanosoma sanguinis* Gruby, 1843, Nov.; *Globularia radiata sanguinis* Wedl, 1850; *Undulina ranarum* Lankester, 1871; *Paramecioides costatum* Grassi, 1881; *Paramecioides costatus* Grassi, 1883; "*Tripanosoma sanguinis* Gruby" of Lanessan, 1882; "*Globularia radiata* Wedl, 1849" of R. Blanchard, 1885; *Trypanomonas ranarum* Danilewsky, 1885; *Trypanosoma ranarum* Danilewsky, 1885; *Trypanosoma renarum* Danilewsky, 1889 [misprint for *ranarum*]; *Trypanosoma costatum* Danilewsky, 1889; *Trypanosoma costatum ranarum* Danilewsky, 1889, p. 61; *Trichomonas ranarum* (Lankester) Danilewsky, 1889; *Trichomonas batrachorum* Danilewsky, 1889; "*Paramoecium loricatum + costatum* Mayer" and "*Paramoecioides costatus* Grassi" of Laveran & *Mesnil, 1901.*

which almost equals in length the remainder of the body; surface of the body coarsely striate longitudinally; endoplasm or parenchyma slightly granular; endoplast ovate, central."

HABITAT.—Blood of frogs (*Rana temporaria, R. esculenta, Hyla arborea*).

FIGS. 66-67.—*Trypanosoma rotatorium*. (After Lankester, 1871, p. 388, figs. 1-2.)



FIGS. 68-70.—*Trypanosoma rotatorium* of the frog: Fig. 68, plaited form; fig. 69, flat form; *c*, centrosome; *f*, flagellum; *m*, undulating membrane; *n*, nucleus; fig. 70, retracted. × about 1,400 diameters. (After Laveran & Mesnil, 1901c, p. 680, figs. 1-3.)

D. TRYPANOSOMA OF FISH.

Trypanosoma cobitis [a] **(Mitrophanow, 1883) of the mudfish.**

(Figure 71.)

SPECIFIC DIAGNOSIS.—*Trypanosoma:* 30 to 40 μ long, 1 to 1.5 μ broad; flagellum 10 to 15 μ. "Body provided with a spiral membrane and a flagellum at the fore end. Parenchyma of body homogeneous. Second variety, body and flagellum only. Movement undulatory, body containing highly refractive spherules. Third variety, plasma-like body, without membrane or flagellum; quickly changes form by sending out processes laterally, and contains two to four refractive spherules." (Crookshank, 1886, pp. 921-922.)

HABITAT.—Blood of the mudfish (*Cobitis fossilis*).

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[a] SYNONYMS.—*Hæmatomonas cobitis* Mitrophanow, 1883; *Trichomonas cobitis* (Mitrophanow) Crookshank, 1886; *Trypanosoma piscium* Danilewsky, 1885, in part; *Trypanosoma fusiforme piscium* Danilewsky, 1885, in part; *Trypanosoma* (*Herpetosoma*) *cobitis* (Mitrophanow) of Doflein, 1901; *Hæmatomonas cobitidis* Lühe, 1902.

FIG. 71.—TRYPANOSOMA COBITIS IN THE BLOOD OF MUDFISH.

a, First variety; *b*, second variety; *c*, third variety; *d*, first variety in a state of diminished activity; *e*, the same after treatment with osmic acid. (After Mitrophanow, 1883, p. 41, fig. 1.)

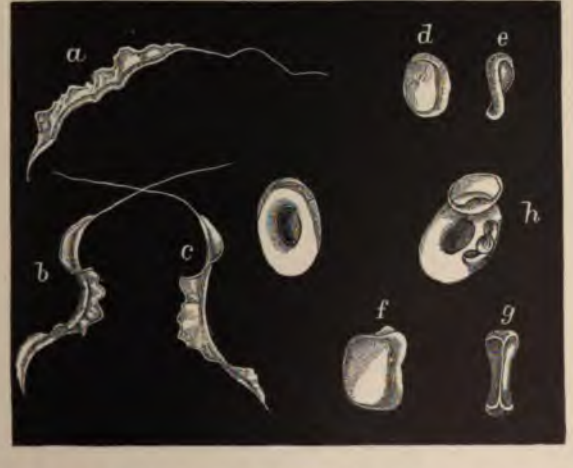

FIG. 72.—*a*, *b*, *c*, TRYPANOSOMA CARASSII IN THE BLOOD OF THE CARP; *d*, *e*, *f*, *g*, *h*, OTHER ORGANISMS IN THE SAME BLOOD.

(After Mitrophanow, 1883, p. 42, fig. 2.)

Trypanosoma carassii[a] (Mitrophanow, 1883).

(Figure 72.)

SPECIFIC DIAGNOSIS.—*Trypanosoma:* "Long bodies, with narrow membrane attached along the whole length; less actively motile. Several forms also observed strikingly smaller than the above; many disk-shaped. Often seen attached to a red corpuscle, setting them in motion by their movements." (Crookshank, 1886, p. 922.)

HABITAT.—Blood of fish (*Carassius vulgaris*).

Trypanosoma Remaki Laveran & Mesnil, 1901, of pike.

(Figures 73–74.)

SPECIFIC DIAGNOSIS.—*Trypanosoma:* Noticed in two forms, described as varieties as follows:

Trypanosoma Remaki parva Laveran & Mesnil, 1901: Very similar to *Tr. Lewisi;* 28 to 30 μ long, including flagellum which is about as long as the body; 1.40 μ broad; body pointed at both extremities, often more pointed anteriorly; protoplasm finely granular; nucleus round or oval, usually near border between anterior and middle thirds of body; "centrosome" small, spherical, near posterior extremity; undulating membrane slightly developed.

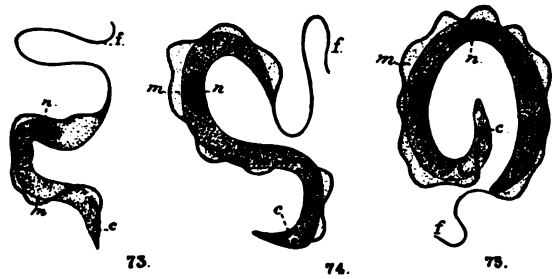

FIG. 73.—*Trypanosoma Remaki parva; c,* centrosome; *f,* flagellum; *m,* undulating membrane; *n,* nucleus. X about 1,800. (After Laveran & Mesnil, 1901, p. 672, fig. 1.) FIG. 74.—*Trypanosoma Remaki magna.* (After Laveran & Mesnil, 1901, p. 672, fig. 2.) FIG. 75.—*Trypanosoma solex: c,* centrosome; *f,* flagellum; *m,* undulating membrane; *n,* nucleus. X about 1,800. (After Laveran & Mesnil, 1901, p. 672, fig. 3.)

Trypanosoma Remaki magna Laveran & Mesnil, 1901: 45 μ long, including flagellum, the body measuring 26 to 28 μ long, 2 to 2.5 μ broad; thicker than *Tr. Remaki parva* and colors more intensely.

HABITAT.—Blood of European pike (*Esox lucius*).

Trypanosoma solex Laveran & Mesnil, 1901, of soles.

(Figure 75.)

SPECIFIC DIAGNOSIS.—*Trypanosoma:* Body 32 μ long, flagellum 8 μ long; anterior extremity often less pointed than the posterior; oval nucleus, containing large granules of chromatin, situated near equator; "centrosome" spherical, larger than in *Trypanosoma Remaki,* and situated toward posterior extremity; undulating membrane well developed.

HABITAT.—In blood of soles (*Solea vulgaris*); France.

E. ? TRYPANOSOMA OF MOLLUSKS.

? Trypanosoma Balbianii[b] Certes, 1882, of oysters.

(Figures 76–81.)

SPECIFIC DIAGNOSIS.—*? Trypanosoma:* 50 to 18 μ long by 1 to 30 μ broad.

HABITAT.—Intestine of oysters (*Ostrea edulis, O. angulata, Gryphæa angulata*) and mussels (*Tapes decussata, T. pallustra*).

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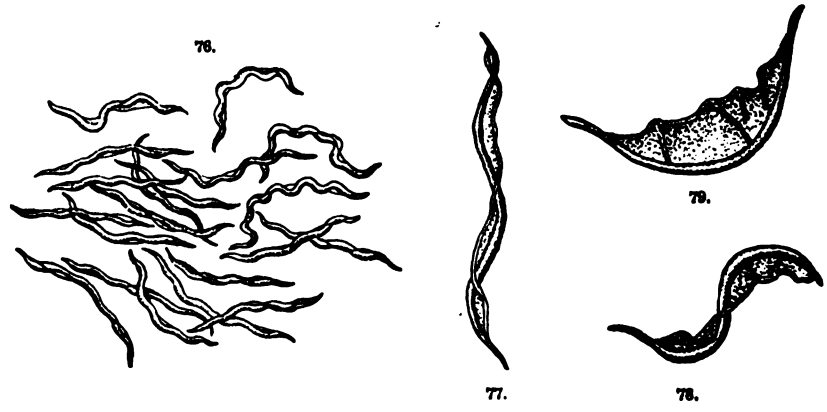
[a] SYNONYMS.—*Hæmatomonas carassii* Mitrophanow, 1883; *Trichomonas carassii* (Mitrophanow) Crookshank, 1886; *Trypanosoma piscium* Danilewsky, 1889, in part; *Trypanosoma fusiforme* Danilewsky, 1889, in part; *Trypanosoma (Herpetosoma) carassii* (Mitrophanow, 1883) Doflein, 1901, p. 71.

[b] SYNONYMS.—*Trypanosoma Balbianii* Certes, 1882; *Tripanosoma Balbianii* (Certes) Balbiani, 1888; "*Trypanosoma Balbiani*" of Danilewsky, 1889, p. 55.

According to recent investigations by Laveran & Mesnil (1901f), this parasite is not a member of the family Trypanosomidæ.



FIGS. 76–79.—*Trypanosoma Balbianii* Certes: Fig. 76, group of living individuals submitted to compression; X 250; retractile crest seen in a certain number of individuals; fig. 77, living individual compressed and colored by methylene blue; X 800; crest quite visible; figs. 78–79, individuals fixed by the vapors of osmic acid, and colored by methylene blue; X 800. (After Certes, 1882, pl. 7, figs. 1–4.)

Genus Trypanoplasma[a] *Laveran & Mesnil, 1901.*

GENERIC DIAGNOSIS.—Trypanosomidæ: Body elongate, provided with a longitudinal lateral membrane, and terminating at each end with a flagellum.

TYPE SPECIES.—*Trypanoplasma Borreli* Laveran & Mesnil, 1901.

Trypanoplasma Borreli Laveran & Mesnil, 1901.

(Figure 82.)

SPECIFIC DIAGNOSIS.—*Trypanoplasma:* 20 μ long (flagella not included), 3 to 4 μ broad; body flattened, often curved in an arch, concave side thicker than the convex side which bears the undulating membrane; anterior extremity pointed, posterior extremity rounded; at union of middle and posterior thirds of body are seen two masses of chromatin of about equal size and of elongate form, their long axis parallel with longitudinal axis of the body; the mass on the concave side of the body is interpreted as the nucleus, that on the

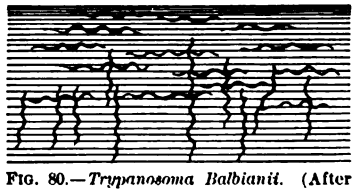


FIG. 80.—*Trypanosoma Balbianii.* (After Certes, 1891, p. 131.)

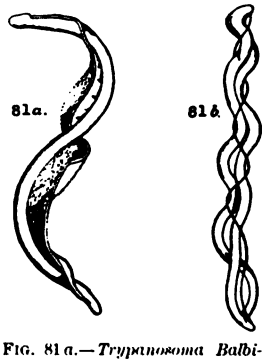


FIG. 81 *a*.—*Trypanosoma Balbianii.* (After Lustrac, 1896 [copied from Doflein, 1901, p. 60, fig. 34 a].)

FIG. 81 *b*.—The same, dividing. (After Lustrac, 1896 [copied from Doflein, 1901, p. 60, fig. 34 b].)

FIG. 82.—*Trypanoplasma Borreli; c*, centrosome; *fa*, anterior (major) flagellum; *fp*, posterior flagellum; *m*, undulating membrane; *n*, nucleus. X about 1,800. After Laveran & Mesnil, 1901, p. 672, fig. 4.)

[a] SYNONYMS.—"*Trypanomonas* Danilewsky" of Labbé, 1891; "*Trypanosoma* (*Trypanomonas*)" of Doflein, 1901; *Trypanoplasma* Laveran & Mesnil, 1901.

convex surface as the "centrosome;" from the "centrosome" extend two flagella, one anteriorly, the other posteriorly; the anterior flagellum borders the undulating membrane, then becomes free; the posterior flagellum borders the convexity of the posterior portion of the body (where there possibly exists an undulating membrane much less developed than the membrane of the anterior portion) then borders the posterior extremity of the body, then suddenly turns on itself and becomes free; flagella, each about 15 μ long, making the total length of the parasite about 50 μ.

HABITAT.—Blood of the redeye (*Leuciscus erythrophthalmus*); France.

FIG. 83.—*Trypanoplasma Danilevskyi*. (After Labbé, 1891, p. 230.)

Trypanoplasma Danilevskyi[a] (Labbé, 1891).

(Figure 83.)

SPECIFIC DIAGNOSIS.—*Trypanoplasma:* 15 to 20 μ long, scarcely 1 μ broad; body elongate, filiforme.

HABITAT.—Intestine of leeches; France.

It is more than possible that this parasite was taken in with the blood of some vertebrate.

TECHNIQUE.

Examine fresh or defibrinated blood. Also, spread blood in a thin layer on a cover-slip, allow it to dry superficially, then fix in absolute alcohol 1 to 2 minutes, and color for 3 to 5 minutes in dilute methylene blue.

Doflein recommends for permanent preparations the same method used for amebæ, or Ziemann's modification of Romanowski's method. The following staining fluids are mixed in a watch glass just before using:

	Grams.
1. One part of the mixture—	
Methylene blue	1
Borax	2.5
Distilled water	100
2. Four parts of the mixture—	
Eosin	.1
Water	100

"This mixture colors in about 10 minutes, and in many cases very nicely differentiated, in that the plasma appears blue, flagella red, and chromatin also red, but of a different shade. If one of the two colors is too intense, place the cover slip in the other color for a short time." Then treat the preparation in the usual way, finally making a balsam mount.

Laveran & Mesnil (1901e) recommend highly the following method:

(1) The blood is spread in a thin layer on a slide, dried rapidly, and fixed in absolute alcohol for 10 to 15 minutes.

(2) The following solutions are prepared in advance: (a) Methylene blue with silver oxide or Borrel blue. Into a phial of about 150 c. c.

[a] SYNONYMS.—*Trypanomonas Danilevskyi* Labbé, 1891; *Trypanosoma* (*Trypanomonas*) *Danilevskyi* (Labbé) Doflein, 1901.

are placed a few crystals of nitrate of silver and 50 to 60 c. c. of distilled water; when the crystals are dissolved the phial is filled up with a solution of soda, and the whole is shaken; there is formed a black precipitate of oxide of silver, which is repeatedly washed in distilled water, so as to remove the nitrate of soda and the excess of soda; then upon the silver oxide is poured a saturated aqueous solution of methylene blue, prepared with Höchst's medicinal methylene blue. These are left in contact for about two weeks and shaken repeatedly; (b) 1 per cent aqueous solution of eosin (eosin soluble in Höchst's water); (c) 5 per cent solution of tannin.

The staining mixture is prepared *when one is ready to use it* according to the following formula:

	Cubic centimeters.
1 per cent eosin solution	4
Distilled water	6
Borrel blue	1

The slide upon which the blood has been spread and fixed is immersed in the staining mixture which has been poured into a Pétri dish, for example, and it is left there from 20 to 30 minutes.

Upon being removed from the bath the preparation is washed very freely with water, then treated with the tannin solution (10 to 15 minutes); it is then washed again freely with water, and then with distilled water, after which it is dried.

When there has formed a precipitate that is a hindrance in the examination, the preparation is washed with essence of cloves, then with xylol, and a fine cloth saturated with xylol is passed over the surface of the preparation. The preparations are better preserved dry than in balsam, and especially better than in cedar oil, in which they rapidly lose their color.

When the staining has been successful, the protoplasm of the *Trypanosoma* stains light blue, the nuclei stain violet and also the centrosomes and the flagella, in their free portion as well as in the part which borders upon the undulating membrane; the undulating membrane remains colorless or takes on a very pale bluish tinge. The blood corpuscles are stained pink, and the nuclei of the leucocytes deep violet.

SOURCE OF INFECTION BY THE PARASITE OF SURRA.

Opinions differ as to source of infection. While the drinking water and herbage, and grain containing feces of rats and bandicoots have been viewed with suspicion by prominent authorities, some authors suspect that flies of the family Tabanidæ act as transmitters of the organism. This latter view is strongly supported by analogy, for tsetse disease, which also is caused by a trypanosome (*Trypanosoma Brucii*) and which some authors look upon as nearly if not quite

identical with surra, is carried by the tsetse fly (*Glossina morsitans*), and *Trypanosoma Lewisi* of rats has been shown to be transmitted by fleas, while lice also may disseminate this same parasite.

Lingard (1899, p. 74), in discussing the methods of infection, assumes "that animals (equines, bovines, solipeds, and buffaloes) acquire surra by the entrance of the *Trypanosoma* into their systems in one of four ways—

"(1) From eating grass and vegetation grown upon land subject to inundation.
"(2) From drinking stagnant water during certain months of the year.
"(3) From the bite of certain species of flies, probably as carriers of the virus.
"(4) From the ingestion of corn soiled with the excrement of the rat and bandicoot."

Of these methods it seems to us that the insect theory is by far the most plausible.

A. FROM THE BITE OF OR INFECTION BY INSECTS AS CARRIERS OF THE PARASITES.

Lingard (1899, p. 75) demonstrated in 1891 that the "body fluids" of certain flies, after sucking the blood of surra animals, contained *Trypanosoma* in varying numbers, and, further, that healthy animals when inoculated with such soiled material contracted the disease after a period of incubation. These facts, taken in connection with the recent experiments on nagana and on rat trypanosomiasis, indicate very strongly that Evans's surra is transmitted by dipterous insects. Lingard mentions *Tabanus* (gadflies), Hippoboscidæ (louse flies), Muscidæ (flies), and Culicidæ (mosquitoes) as bothering the animals in India. He quotes the following (1899, p. 78) from "Nawabkhan, the camel jamadar of the Third Punjab Infantry," who "has the reputation of knowing more about the camel than anybody else in the district:"

"The prevailing opinion among the natives in this district is that surra is caused by the bite of a large brown fly (the size of a small bee) called *Bhura dhang*. In the month of May that fly comes from the ground in jungle land that has been under water. In June and July the flies are very numerous and in full force; about the 15th of August they begin to diminish, and early in October they are obtained with difficulty. The fly bites horned cattle and donkeys, but these suffer no ill effects; it bites men, and a painful swelling follows; it bites horses and camels, and gives them a fatal disease known by several names, such as *khanhog*, *doaia*, and *surra*, depending upon the several stages. *Phipri* is another name by which it is known among camels. I know of no reason for saying that the fly causes the disease except the common tradition of my people." (Griffith Evans, 1880.)

Lingard (1899, pp. 22, 78–79) further states:

"*Flies.*—On the 24th of September at Mohand I demonstrated microscopically the surra hæmatozoon in the blood of flies taken from the bodies of horses suffering from the disease, in the blood of which the protozoon was present at the time.

"The presence of the *Trypanosoma* of surra in the body fluids of certain species of flies caught near to or on the bodies of animals (horses, dogs) suffering from that disease was frequently observed and demonstrated at the Poona Laboratory in

1890. We have before pointed to the fact that when once the disease exists its further development in other animals is frequently due to the bite of flies, which carry the soiled blood on their piercing organs.

"The chief question which presented itself for solution was whether the *Trypanosoma* is ever to be found in the body fluids of flies and ticks (1) during the hot season of the year, when it is very exceptional to find a case of the disease, or (2) during the early part of the rains before the disease has manifested itself in animals. In order to elucidate the above problems it was necessary to visit the localities known to be surra centers during the hot season, but just before the rains usually commence at the end of May and beginning of June, and a second time about the end of August and beginning of September, the middle of the rains, on each occasion to systematically make a very large number of microscopical observations of the different fluids to be examined.

"With this object in view (1) in the hot season, numerous specimens of the thoracic and abdominal fluids of the following species of Diptera were submitted to microscopical examination: (*a*) Large green-headed fly (*Tabanus lineola*), (*b*) large brown-headed fly (*Tabanus tropicus*), (*c*) horse and cattle fly (*Hippobosca maculata*), (*d*) small variety infesting dogs (*Hippobosca*), (*e*) local varieties of the Muscidæ, and (*f*) mosquitoes (Culicidæ).

"Flies obtained from every available source were submitted to microscopical examination. During a sojourn in a surra locality we engaged coolies to supplement our own staff; consequently fresh supplies of Diptera were brought in several times daily. These were carefully examined in the fresh state. In different districts one or more species of flies were generally found to predominate, but they varied also in number and species according to the season of the year.

"The microscopical examination of the water, mud, fresh-water shellfish, flies, and ixodes collected during the hot season observations failed to reveal the presence of any form of *Trypanosoma*.

"(2) During the rainy season tour, hundreds of flies belonging to some ten different species, together with ticks from equines and canines, were collected and their body fluids submitted to microscopical examination, but in all cases with negative results as regards the presence of the *Trypanosoma*.

"Veterinary Capt. G. H. Evans, during his tours in Burma, has been good enough to make a large number of microscopical observations for this report, but has failed to detect anything like the surra hæmatozoon in the jungle Diptera examined. He states that a fly exists in Burma, a little larger than the common house fly, with body yellowish in color and with its legs bent on themselves. At the point where this fly bites a small extravasation of blood appears just under the skin, which shortly after presents the appearance of a blood bleb, such as follows a contused wound. These insect pests are present in great numbers just before thunderstorms at the termination of the hot season, not only in the plains, but also at Thandaung in the Karen and Binjyi in the Shan Hills. The gaur (Indian bison) and tsaing suffer from rinderpest and foot-and-mouth disease, yet these animals have, up to the present, never been observed with surra, although careful search for the disease has been made. They live in heavy jungle where the flies are so annoying to them that they have to go in the open to escape their attacks."

Griffith Evans (1881, p. 8), in his excellent discussion, appears to be the first European to suggest flies as transmitters of surra. He says:

"It is not improbable, however, that those flies so excessively troublesome at Jutta and other outposts, which bite horses so that the blood streams down the legs as if it had been squirted on, do convey the disease from one horse to another by inoculation. It is a fact that the disease does spread mostly at those posts where the horses are closely packed and the flies are in greatest numbers; but those are

the posts also where the drinking water is worst; so that it is extremely difficult to form a true opinion upon this subject without further experiments. However, the indications at present are that horses affected with surra should be kept at a distance from other horses during the season when those flies are common. They were becoming scarce in the early part of October. I obtained two specimens with difficulty. I do not know yet what is their scientific name. They are very large, of a brown color, and common in many parts of India. The natives call them bhura dhung, which means a great needle-like sting. There is a common opinion prevailing among the natives of the Dera Ismail Khan district that this fly is the cause of the disease. I shall refer to this again, and merely mention it here because I think the fly may sometimes propagate the disease by inoculation, and thus be an item among the causes to account for the spread of the disease more at some posts and in some years than others, though the disease would exist independently ot them. When the horses stand close together the fly is able to go from one horse to another before the blood about its mouth is dry; whereas if he had to travel some distance through the dry air, in the hot sun, the virus of the blood would perhaps be destroyed."

Pease (1897, p. 560) says that the natives have for years attributed surra to *Tabanus tropicus*.

The fly theory of surra explains satisfactorily a number of facts which have long been observed in connection with this malady. Thus, surra is a disease of wet weather, and, as we have already pointed out, biting flies are practically creatures of moisture. They breed more rapidly in wet weather, and pupæ are more likely to issue when the surrounding media are moist than when they are dry. Howard,[a] in discussing the Tabanidæ, says:

"The adults are great water drinkers, and are usually most abundant in the vicinity of inland ponds and streams. This has suggested to Porchinsky, the Russian entomologist, the desirability of coating such ponds with kerosene, and his experiments resulted in the destruction of great numbers of Tabanids.

"The larvæ of the Tabanidæ live in the earth or in water and are carnivorous, feeding upon soft-bodied insects and water snails. The spindle-shaped brown or black eggs are deposited in summer in groups attached to the leaves or stems of herbage. The gadflies vary greatly in color and size, and the smaller ones of the genus *Chrysops*, sometimes called 'deer flies,' are frequently quite small and colored with yellow or green. The larger ones vary through gray and brown to black. Our largest gadfly is *Tabanus americanus* Forst., which is 1¼ inches long, and has a wing spread of 2½ inches. It inhabits the Southern States. About 1,500 species are known, and perhaps 200 occur in this country."

The importance of moisture in connection with biting flies in general is also ably set forth by Miss Murtfeldt[b] in the following passage:

"The horsefly,[c] very numerous and annoying to cattle during May and June, entirely disappeared some weeks since, the manure drying out too rapidly to afford the larvæ time to develop. Even the housefly and other annoying Muscidæ are comparatively few in number."

[a] The Insect Book, 1902, pp. 131–132. New York.

[b] Drought, Heat, and Insect Life, by Miss Mary E. Murtfeldt, Bull. 31, n. s., Div. Entom., U. S. Dept. Agric., 1902, pp. 97–99.

[c] Reference is apparently made to *Stomoxys calcitrans*.

George H. Evans (1899, p. 41) states that in Burma flies are particularly bad after the first few thunderstorms. Again, surra is acknowledged to be more common in moist places, as near rivers, ponds, and marshes. In this connection it may be pointed out that flies also are more common in such localities.

Nariman & Vaz (1893, p. 403) are authority for the statement that there is a common belief among natives that animals acquire surra by eating filth from the refuse heaps outside of the villages. This belief also supports the fly theory, for refuse heaps attract flies, and on this account there would be a greater chance of infection when horses feed around such heaps.

Pease (1897, pp. 557–558) has stated that he has seen all the dogs of a village infected from eating the carcasses of animals which died of surra, and that cats become infected in the same way. It seems to us, however, that it is perhaps an open question whether the dogs were actually infected through eating the meat or whether the carcasses had attracted flies which in turn had bitten the dogs. Both explanations seem plausible, for the parasites might enter the dogs through some wound in the mouth, such as could easily be made while gnawing bones.

Rodgers (1901, p. 164) has recently experimented with the transmission of surra by flies. In every case where they were kept from one to four or more days after biting an infected animal no disease developed when these flies bit healthy animals; but fresh flies—that is, immediately after biting infected animals—produced infection in healthy animals. No developmental stages of the parasite were found in the tissues of flies, and such insects fed to a rat failed to produce infection.

The fly theory also agrees entirely with experimental subcutaneous inoculations. It has been abundantly demonstrated by various observers that surra may be transmitted by subcutaneous injection, and also that horses contract surra readily in the usual period (5 to 7 days) when a small scratch on the muzzle is smeared with a trace of soiled blood. The bite of a fly or the soiling of a scratch by a fly whose beak, body, or legs are soiled with undried trypanosomatic blood corresponds to these cases of experimental infection.

It is very noticeable that in speaking of prevention, a number of authors advise removing the animals to more healthful ground, and it seems quite reasonable to assume that such a change would naturally be to a region where flies are less common.

Finally, Steel (1886a, p. 170) records that gray and white mules suffer most, and in this connection we may point out the fact that, according to Professor Wallace, flies attack light-colored animals more than they do dark ones. Whether they actually do attack lighter animals more, or whether they are only seen more easily on a light

background, is perhaps an open question. There can, however, be little doubt that certain mosquitoes attack whites more than they do negroes, and the apparent relation between the white and gray mules, the flies, and surra, is, to say the least, a tempting explanation.

We are by no means convinced as yet that biting insects play any *necessary* rôle in the life history of *Trypanosoma* comparable to the rôle mosquitoes (of the genus *Anopheles*) play in the sexual generation (sporogony) of *Plasmodium*, the cause of malaria. Up to the present time far too little is known regarding the variations in the life cycle of the Trypanosomidæ to warrant any but the most reserved conclusions, but the indications, to our minds, are that whether or not the parasite of surra *may* pass a sexual stage of reproduction in *Tabanus* (gadflies), such a sexual stage does not appear to be necessary for the dissemination of the disease by insects. In other words, the indications seem to be in the line of the explanation given by Griffith Evans (1881, p. 8), namely, that flies with undried surra blood on their beaks may transmit the disease. If these indications have been correctly interpreted by us, consistency would compel us to admit that not only *Tabanus tropicus*, but any other biting or piercing insect, such as *Stomoxys calcitrans*, and even the ordinary housefly (*Musca domestica*), might act as transmitters. Accordingly, we at present are inclined to believe that if by any chance a surra patient were brought to this country, the disease could spread here, even if no Asiatic insects were accidentally introduced at the same time. In other words, our American biting flies, and even mosquitoes, must be taken into consideration as possible or even probable disseminators of the contagious material.

Some flies which Dr. J. J. Curry, of the medical corps of the United States Army, collected in the Philippines have been forwarded by him to Dr. L. O. Howard, entomologist of the United States Department of Agriculture, and have been determined as the common biting stable fly, *Stomoxys calcitrans*. Dr. Curry states that he collected the specimens in question from surra horses, and that in his opinion this is the fly which is the common transmitter of the disease in the Philippines. He has repeatedly found the surra parasite in the stomach and in the proboscis of this *Stomoxys*, but we are not informed that any direct experiments have been made to transmit surra by means of the insect in question.

B. BIRDS AS POSSIBLE TRANSMITTERS OF SURRA.

Lingard (1899, p. 22) also mentions the possibility of the accidental transmission of surra by crows. He says:

"Several instances presented themselves where both healthy and diseased horses were standing side by side; both classes of animals presented open sores (galls) on their bodies, generally on either side of the spinal column. Crows were perched on their backs, pecking and scratching the sores, and in several instances drawing blood.

The birds moved freely from the back of one animal to the other, and no doubt this is one source by which the disease is spread. This would occur with the greatest ease either with their blood-stained beaks or with their soiled feet coming in contact with a raw surface, for I have proved that a minute fraction of a drop of blood containing surra hematozoon is capable of conveying the disease to the horse if spread over a scratch in the skin of the animal."

We see nothing improbable in this view. In fact, surra appears to us to be a wound disease, transmissible through any sort of wound, whether it be made by insects, crows, syringes, knives, or anything else, provided undried trypanosomatic blood comes in contact with the freshly wounded surface.

C. INFECTION BY INGESTION OF BLOOD OF AFFECTED ANIMALS.

A number of experiments have been made to transmit surra to animals by feeding the blood of infected animals, and attention has already been directed to the statement that dogs and cats are alleged to become infected through eating surra carcasses. We are inclined to accept this as a possible method of transmission, but in this connection we would direct attention to the following points:

(1) It does not appear to be satisfactorily demonstrated (*a*) whether the parasites have forced their way through the intestinal mucosa (as does not seem impossible: Compare bacterial infections; tuberculosis; trichinosis; *Balantidium coli*, according to Strong's recent interesting results); or, (*b*) whether the hematozoa have entered the system through some intestinal wound. (2) It also does not appear in the ingestion experiments that authors have always excluded the possibility of accidental infection by insects. Infection by ingestion of blood does not at present come into very serious consideration in connection with the transmission of surra from horse to horse, unless perhaps the horses should lick fresh, bleeding fly bites, and thus accidentally smear a wound in the mouth with trypanosomatic blood.[a]

D.? CONGENITAL INFECTION.

According to Lingard (1895, p. 12), no *Trypanosoma* has been found in the fetuses in case of rats, even when the gravid mother was found infected. This conclusion is based upon a number of observations, and apparently establishes the fact that, at least under normal conditions of the placenta, surra is not congenitally infectious. (See also pp. 111, 128.) This view is supported by other authors also.

[a] An article has just been obtained from Rodgers (1901), who shows (p. 168) that, if surra blood is fed to an animal with an abraded surface with which the blood comes in contact, infection will take place. If there is no abrasion, no infection follows.

E.? FROM DRINKING STAGNANT WATER AND EATING VEGETATION GROWN UPON LAND SUBJECT TO INUNDATION.

In discussing infection from these sources, Lingard (1899, pp. 74–75) says:

"The question of grass and water being the carriers of the contagium of surra is so intimately associated that it will be as well to consider these two factors together in their relation to the causation of the disease. The distribution of this malady seems to be entirely influenced by the physical aspect of the country. It appears to be chiefly brought about by the occurrence of floods and inundations, being far more prevalent in those parts of the country where these occur than in the higher and drier portions. It is far more common in the vicinity of the rivers and canals than in portions of the country where water is scarce. It is not usual for the natives of India to make any provision for the maintenance of their animals in the form of hay or dried grass. The usual custom is either to graze their cattle where grass is to be found or to cut it from the jungles and wastes as it is required. Toward the end of the hot season grass on the higher lands has become burnt up; at lower levels, especially at the bottoms of nalas, swamps, and ponds, where water has been lying till a much later period, an abundant supply can generally be found, and it is from these sources that it is procured.

"Similar conditions operate at intervals during the wet season, or directly the rains have ceased, especially in those parts of this country where the temperature is high at this time of the year. The lands bordering on rivers and streams, or those which are low lying, become flooded, the herbage is covered with water, which in some cases, when the land has a clayey subsoil, disappears almost entirely by gradual evaporation, and such places are favorable for the development of low forms of life, and possibly for the *Trypanosoma*. Animals, therefore, which daily consume grass and drink water from such localities run a risk of taking into their systems the contagium of this disease. In confirmation of these statements we may mention one example from many collected. The inhabitants of a village "Naoni" in the Ghaziabad Tahsil, of the Meerut district, visited by Veterinary Captain Pease in 1895, informed him that some 40 out of 60 camels attacked had died out of a herd of 250. The people now drive the camels away to the Bangar or higher lying grounds during the rains, and water those animals which remain in the lowlands from wells only, in order to escape the disease. They attribute the disease to stagnant water, and do not allow their camels to drink at open places until the water has stood for a considerable time and become 'pakka' (wholesome). On the other hand, Veterinary Captain G. H. Evans reported the case of a pony which contracted surra in a compound in Rangoon. The grass was obtained by its attendant from any source available, while the water supplied to the animal came from the municipal supply pipes. This was the first case of surra acquired in that city observed by the above officer during a residence of some 6 or 7 years."

Lingard's presentation of this case does not absolutely convince us that either water or grass conveys the disease. There is nothing at present known in connection with the biology of any *Trypanosoma* which would lead us to look seriously upon the grass and water as sources of infection with surra, notwithstanding the fact that this method of infection has been referred to by so many authors. Naturally, stagnant water will not improve the health of animals, but, on the contrary, will increase the infection with parasitic worms, and so tend to reduce the condition of the stock. Futhermore, insects

will be present in greater numbers under the conditions described, hence these localities will naturally present a greater chance for the spread of the disease. Our remarks are not to be interpreted as a denial of the possibility of infection in the way described, but simply as an expression of reserve or perhaps skepticism upon this point, pending further investigations. Our skepticism finds decided support in the remarks by Pease (1897), quoted on page 95 of this report.

F. P INGESTION OF GRAIN SOILED WITH EXCREMENT OF THE RAT AND THE BANDICOOT.

In discussing the subject Lingard (1899, p. 76) says:

"In 1891 experimental inoculation of equines proved that out of 12 animals inoculated with soiled rat's blood 4, or 33 per cent, contracted surra and died of a virulent form of the disease in an average of 7 days. The above experiments raised the question as to how rats could cause the disease in horses, for the food would rarely, if ever, be soiled with the blood of these small animals. It therefore only remained to be tried whether the excreta of rats, in whose blood the infusorian was present at the time of its collection, could cause the disease when mixed with grain. Experiments with this end in view were carried out, and one Australian horse contracted surra in 1893, the incubation period occupying some time between June and September, during which the animal received daily rat excrement mixed with its ration of corn. This was evidence that when a horse is made to ingest soiled material day by day surra may finally be contracted, but whether the disease was ever actually produced in the natural course of events by this means at that time, there was no testimony forthcoming. Inquiries were instituted in different parts of India in order to discover whether any folklore existed on the subject, and syces and keepers of horses were interrogated for a similar purpose. In June, 1895, one gentleman, with many years' experience in India, stated 'that it was a fixed idea in the minds of many natives in the Northwest Provinces and Oudh that if horses were allowed to eat corn soiled with rat excrement some of them would be more than likely to die within a few months.' Again, the following statement was made by an old syce: 'It is a common belief among syces that rat's dung in the corn given to horses makes them ill.' Further testimony with regard to small animals was obtained to this effect: 'Some years ago we lost a couple of goats, and the native who tended them said death was due to the rat's dung we found among the stock of gram the animals had been fed upon.'

"From the above statement it will be gathered that animals can acquire the *Trypanosoma*, or organism of surra, by different means. The thousands of equines which have succumbed to that disease in the Punjab alone have to shift for themselves, and under no circumstances obtain anything as fodder but the grass they can find and water from the nearest source. Therefore the question of rat excrement can be at once excluded as a factor in the causation of the disease in that class of animals. But with regard to the question of surra being communicated by the bites of a fly, we know that when once the disease is started it may be reproduced to any extent by these insects. The evidence put forward with regard to the effect of rat excrement in corn is also of great importance to the horse owner in India."

We are inclined to accept Lingard's reasoning in this case with double reserve. While it appears that rats may contract horse surra, it has not been shown that *Trypanosoma* are found in the excrement either of horses or of rats, nor is it clear to us that during the experi-

ment mentioned, extending over three to four months, the necessary precautions were taken to exclude fly bites and other factors. If, in fact, *Trypanosoma* accidentally reached the feces through intestinal hemorrhage, it is not clear how they could be infectious, for rat feces dry rapidly, and drying appears to kill this parasite, as has been proved also for other species of *Trypanosoma* (see p. 113). Finally, even if it is assumed that the rat trypanosomiasis found was identical with the horse surra, it is at least possible that it might have been transmitted by rat fleas perhaps as easily as by the ingestion of excrements.

SYMPTOMS OF SURRA.

GENERAL CLINICAL PICTURE.

Lingard (1893, pp. 62–64) has given the following summary of symptoms—the most complete summary which has as yet been published by any author whose papers we have been able to consult:

"Before describing the symptoms of surra, it will be necessary first to divide cases of the disease under two different heads, viz: A. Those which have contracted the disease in the natural course of events; B. Those which have acquired the disease by inoculation.

"*A. Symptoms of the disease as observed when contracted naturally.*—The invasion of this disease is usually marked by symptoms of a trivial character; the skin feels hot, and there may be more or less fever; there is also slight loss of appetite, and the animal appears dull and stumbles during action; thus early a symptom sometimes appears, which may be the first intimation received of the animal's indisposition, and which, as a guide to diagnosis, is of great importance; it is the presence of a general or localized urticarial eruption. If the blood be examined microscopically it may be found to present a normal appearance, but in the majority of cases a few small, rapidly moving organisms will be observed, giving to the blood, as it passes amongst the corpuscles, a peculiar vibrating movement, which if once observed will not readily be forgotten. If the hematozoon has not been discovered in the blood for some days, the before mentioned may be the only symptoms noticeable, and as a rule, when treated with febrifuges, the horse quickly improves in health and the appetite returns. This condition does not last for more than a few days, when the animal is again observed to present a dull and dejected appearance, and on examination well-marked symptoms are found; the skin is hot, the temperature more or less elevated, 38.7° to 40° C.; the pulse full and frequent, 56 to 64 beats per minute; the visible mucous membranes may appear clean, but the conjunctival membranes, especially those covering the membrana nictitans, are usually the seat of dark-red patches of ecchymosis, varying in size in different animals. There is more or less thirst and slight loss of appetite, the animal eating its corn and green grass, whilst leaving all or a portion of the dried grass with which it has been supplied. At the same time there are slight catarrhal symptoms present, including lachrymation and a little mucous discharge from the nostrils. Occasionally at this period of the disease the submaxillary glands may be found enlarged and perhaps somewhat tender on manipulation. One symptom is markedly absent, namely, the presence of rigors, or the objective signs of chilliness. In addition it will be noted that there is some swelling and edema of the extremities, generally between the fetlock and the hock, which pits but is not painful on pressure, and in the cases of horses there may be present also at this stage of the disease some swelling of the sheath. When the fever

and concomitant symptoms have declared themselves during a short period, one thing becomes especially noticeable in every animal attacked, namely, the rapidity with which it loses flesh. If the blood has been examined microscopically during the second period of fever, at first a few hematozoa will have been observed in it, which day by day increase in number and reach a maximum, where they remain for a varying period, or at once suddenly or gradually disappear during the period of apyrexia. After the fever and the accompanying symptoms have for the second time been present for some days, the period varying from one to six, the animal is found to have lost the dull, dejected appearance and to look bright. The elevated temperature has fallen and, in some cases, has attained normal or even subnormal limits. The visible mucous membranes are clean and the conjunctival petechiæ begin to fade; the pulse, however, will be found to be weak and thready in character, but the appetite excellent, and, in fact, if it were not for the loss of flesh and slight edema of the extremities, there would be little to show that the animal was ailing. But unfortunately this condition does not continue for any length of time, for again the temperature is elevated; in the course of a few hours the thermometer registers a still higher degree, the animal is dull and dejected, and by the following day the visible mucous membranes present a yellow tinge; large ecchymoses, dark in color, appear on the conjunctival membranes; the action of the heart is irritable, the pulse full and quick, or at times intermittent, and regurgitation may be observed in the jugulars; the breathing is quickened and the individual respirations shallow. On watching an animal in this condition it may be noticed that it takes seven to eight very short inspirations, and these are followed by a much more prolonged and sonorous one; at the same time the breathing is more abdominal than thoracic in character. On examination of the extremities it will be found that the swelling and edema have increased considerably, and that on the undersurface of the abdomen, where it was previously confined to the sheath, it has now commenced to spread forward along the subcutaneous tissue between the skin and the muscles. During the whole of this time the appetite will have varied little, and the evacuations will be only slightly, if at all, altered in character. In the blood a repetition of the previous events takes place, the hematozoa make their appearance and run up to a maximum, and again suddenly or gradually disappear according to the length of the fever period. These periods alternating with and without fever may go on for a considerable time. The progress of the disease is variable, and greatly depends upon the condition of the animal attacked, the weak ones succumbing very rapidly; but each bout of the fever brings with it, as a rule, an increase in the severity of the symptoms. There is augmented yellowness of the membranes, fresh crops of petechiæ on the conjunctiva, a collection of gelatinous material at the inner canthi, which at times becomes red in color from an admixture of blood, and which on microscopical examination is found to contain a varying number of the surra hematozoa; increased swelling and edema of the extremities and abdomen, which now extends between the fore limbs and up the chest. During this time the wasting has been steadily progressive, especially the muscles of the back and those surrounding the hip joint and the glutei.

"Toward the termination of the disease, it will be noticed that an animal is disinclined to move, and when made to do so there will be manifest loss of power over the hind quarters, somewhat simulating a slight partial paralysis, and the hind quarters of the animal reel from side to side. In connection with this it may be noted that there is frequently present paralysis of the sphincter ani and a dilated condition of the anus. These symptoms taken together point to some interference with the normal functions of the spinal cord in the lower dorsal and lumbar regions, and are probably due to pressure caused by an exudation within the spinal membranes. In many cases shortly before death the heart's action becomes exceedingly violent, shaking the whole frame at each beat, so that the sound can be heard at some distance from the animal. In some of these cases the animal may suddenly drop dead; in others

the emaciation and weakness become so pronounced that the animal falls to the ground, and, after a short bout of struggling, succumbs to the disease. In other cases, again, the animal falls to the ground and appears to be suffering from acute pain, struggles violently, sweats bedew the body, and the respirations are very hurried. The struggles soon exhaust the patient's strength, and for a time it lies quiet; soon, however, the struggles commence again, and this continues until death occurs.

"*B. Those which have acquired the disease by inoculation.*—Twenty-four hours after the subcutaneous injection of a small quantity of surra blood, in the great majority of cases, a small, circumscribed, and somewhat raised swelling is noticed at the seat of inoculation. After 48 hours the tumor has increased in size, and is accompanied by some edema; it presents a certain amount of tension of the parts involved, and is generally tender on manipulation. These conditions continue to increase, until by the fourth day the tumor may measure 3 or 4 inches in one direction, by 2 or 3 in the other, and raised to the extent of an inch or an inch and a half above the surrounding tissues, or in some cases present an almost circular form throughout. It will be also found that, if the tumor be firmly grasped, it is not fixed, but can be lifted up from the subcutaneous tissue. According to the nature and amount of the inoculated blood so will these symptoms rapidly present themselves, and either attain a maximum or be retarded, until, varying from the fourth to the thirteenth day, the tumor at the seat of inoculation will be found to have lost a certain amount of its tension and tenderness. From this date the swelling and edema will gradually begin to grow less, until, finally, after a period of 10 to 14 days, the only sign left of the former swelling will be a slight thickening of the skin over the point of injection; but at the moment when the tension and tenderness of the parts at the seat of inoculation become suddenly decreased, a symptom of the utmost importance clinically takes place, viz, at that moment the organism of surra enters the blood of the general circulation.

"The temperature on the day of inoculation, and in fact for several days afterwards, may remain normal in character, there being only a few points difference between the morning and evening observations. In other cases there may be a slight rise from the first evening, and a gradual progressive rise until the swelling at the seat of inoculation shows signs of reduction in size, when the temperature generally takes a decided rise again, and may attain 40° or 41° C. This elevation will last a varying period of from 2 to 6 days, and on the day following its onset the ordinary symptoms of fever will be noticed; and in addition there will be petechiæ on the conjunctival membranes, lachrymation, a slight mucous discharge from the nose, and in severe cases some oedema of the lower portion of the extremities, and perhaps of the sheath in horses. At the termination of the period of fever, the temperature will be found to have fallen to normal or nearly so; the animal will present a brighter aspect, and there is every appearance of its return to health; but in a few days the animal again appears dull and semisomnolent; the temperature becomes elevated, and a relapse takes place, and a repetition of all the symptoms in the primary paroxysm, including the reappearance of the hematozoon, is observed."

Griffith Evans (1881, p. 2) states that the symptoms of surra should be divided into (1) those common to other maladies, and (2) those characteristic of this disease. Invasion of surra, acquired in the ordinary way, is that common to all low fevers.

Surra in camels.—According to Hagger (see Lingard, 1899, p. 35), the most prominent symptoms in the camel, in addition to the fever, are swellings which appear on the sides of the chest near the pad and in the sheath and scrotum of males and in the udder of females. These swellings form into large abscesses containing an enormous

quantity of thick cream-colored pus. From the first to the last there is progressive anemia, and, although the appetite generally remains good, the animal rapidly wastes away until it becomes a mere living skeleton. The parasite is not present in the blood continuously during the whole course of the disease. The periods during which it is present are marked by elevation of the body temperature (fever), which rises in some cases to 106° F. and sinks to the normal during the intermission, when the parasites are absent. The disease is invariably fatal in the horse, but the camel men aver that a small percentage of camels, which can tolerate it for three years, recover.

Surra in cattle.—According to Lingard (1899, pp. 80–88), surra will undoubtedly develop in bovines and buffaloes, but these animals do not appear especially susceptible to the disease; they may, in fact, recover from the attack, put on flesh, and appear in robust health.

Surra in wild animals.—We have scarcely any information at present in regard to surra in wild animals, but it seems very probable that some wild animal will be found which suffers from the disease in but a slight degree and which therefore will be able to keep up the infection of a district from year to year. Curry (1902) has recently reported surra in the Philippine "caribao" [kerabau, *Bubalis kerabau*].

ANALYSIS OF SYMPTOMS.

ONSET AND INCUBATION.

There is no history of a definite *onset* (Burke, 1891, p. 268; 1897, p. 191), and the condition is progressive, usually with a number of relapses. According to the Veterinary Journal, London (1896, p. 177), there is rarely an opportunity to note early symptoms, the attack usually being a mild one, with the animal a little dull and off its feed, but after a few days' rest, it apparently recovers, and the owner sends it back to work. The attack is somewhat of a bilious fever type, the animal being dull, listless, and leg-weary.

The *period of incubation* is apparently subject to considerable variation. It is 6 to 8 days (2 to 7 days, Steel, 1886a, p. 255) in experimental cases caused by inoculation with or ingestion of blood taken from animals affected with surra; if the blood is from a dead animal, the incubation may be prolonged to 13 days; in cases where the blood has been diluted with water, and been given by mouth, symptoms may not appear for even 75 days. (Hayes, 1898, p. 481.)

According to Lingard (1893, pp. 55–58), the period of incubation varies according to circumstances:

"(*g*) *The latent period of surra*, or, in other words, the time which elapses between the introduction of the *materies morbi* into the system and the first appearance of the hematozoon in the blood of the general circulation, will be found to vary consider-

FIG. 84.—HORSE NO. 21 SHOWING THE SWOLLEN AND EDEMATOUS CONDITION OF THE EXTREMITIES, SHEATH, AND UNDERSURFACE OF THE ABDOMEN ON THE NINETEENTH DAY OF THE DISEASE.

(After Lingard, 1883: p. cl.)

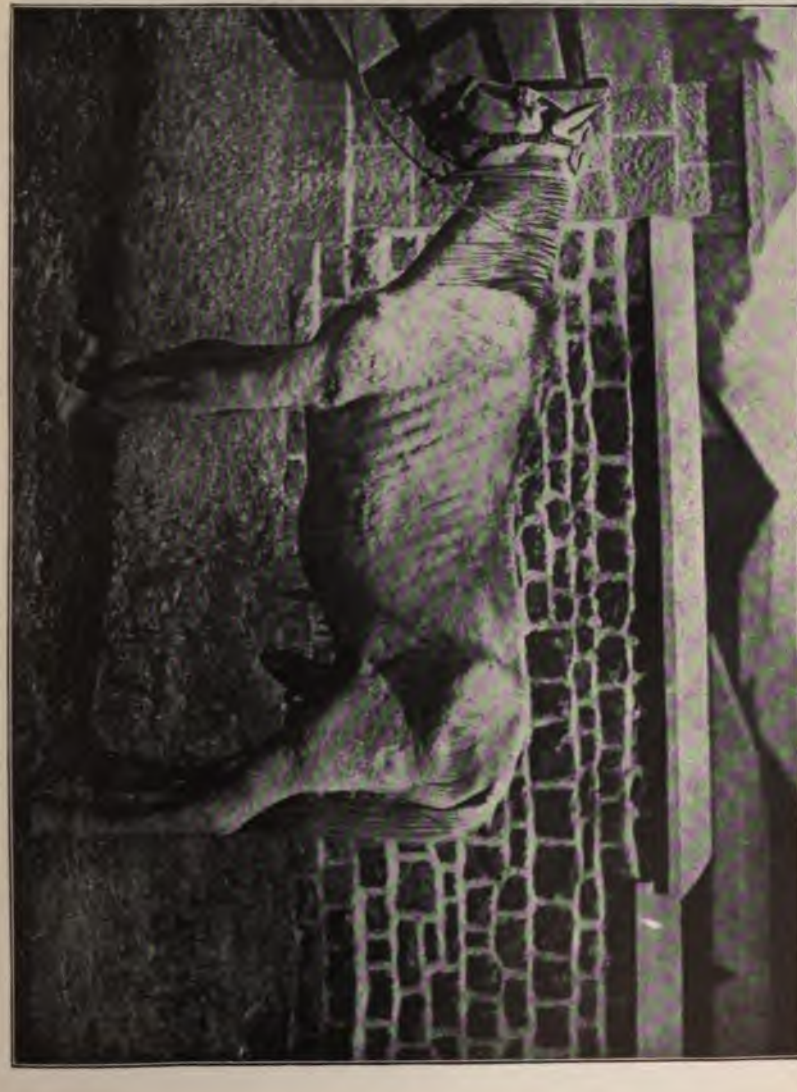


Fig. 85.—Horse No. 55, showing Condition on Twenty-second Day.

(After Lingard, 1888; p. clxviii.)

Fig. 86.—Horse No. 89, showing Condition on Fiftieth Day of the Disease.

(After Liautard, 1899, Pl. I.)

Fig. 87.—Horse No. 89, after successful Treatment.

(After Lingard, 1899; Pl. II.)

Fig. 88.—Pony in Pajamas, as a Protection against the Tsetse Fly.

(Negative by Lieut. T. L. Johnson, A. S. C. Copied from Stordy, 1899, p. 14.)

ably according to certain circumstances. The chief conditions which influence it will be found under the following headings:

"I. The species of animal inoculated.

"II. The means used for inoculating the animal.

"III. The kind of fluid used for inoculation, viz: (*a*) blood; (*b*) serum; (*c*) fluid taken from the tunica vaginalis testis; (*d*) fluid taken from the pericardial sac; (*e*) cerebro-spinal fluid.

"IV. Whether the fluid used for inoculation was drawn ante- or postmortem from the animal affected with surra:

"(*a*) *Antemortem.*

"(*i*) If during a paroxysm, the number of hematozoon present at the time of inoculation.

"(*ii*) If during an intermission or an apyrexial period, the presence or absence of anything on microscopical examination.

"(*b*) *Postmortem.*

"(*i*) The number of hours that were allowed to elapse between death and the inoculation.

"(*ii*) The number of hematozoa in the blood just previous to death.

"V. The quantity of the fluid introduced into the system of the animal, either by—

"(*i*) Direct injection into the general circulation.

"(*ii*) Gastric ingestion.

"(*iii*) By subcutaneous inoculation.

"(*iv*) By smearing on an abraded surface or slight cutaneous incision from which no blood escaped.

"(I.) THE LATENT PERIOD IN NATURALLY CONTRACTED CASES.

"A most difficult point to clear up, and one which up to the present has not been recorded, is the latent period of surra in cases in which it is contracted naturally. The difficulty can more readily be understood when it is recognized that the contagium is, in all probability, taken into the system of the animal, together with its forage or water, or perhaps with both; and that at a subsequent period, when the symptoms of disease become evident, the animal may be in a different part of the country altogether.

* * * * * * *

"(II.) THE LATENT PERIOD, WHEN THE CONTAGIUM IS GIVEN BY THE MOUTH.

"(*a*) Gastric ingestion of a considerable amount of soiled blood.

"(*b*) In small doses in water, following more closely the way in which animals are supposed to contract the disease naturally.

"(*a*) *By gastric ingestion of a considerable amount of soiled blood.*—On the evening of September 29, 1880, Evans experimented upon a fairly healthy aged mare by administering 20 ounces of blood drawn from the jugular vein of an animal suffering from surra. On the morning of October 6, the blood when examined microscopically was swarming with very active parasites. In this case an observation was made on the 4th of October, to the effect that the temperature was 99.8° F. (37.6° C.); blood examined, but no parasite found; but there is no note on the following day, the 5th, regarding the condition of the blood, although the temperature is recorded as having been 102.2° F. (39° C.). Consequently I am inclined to believe that the hematozoon would have been found on the 5th if it had been looked for, taking into account the rise of temperature and the fact that the hematozoa were swarming in the blood on the morning of the 6th. In this case, then, the latent period may be said to have been only 5.5, or at the most 6.5 days.

"On the morning of the 30th of September, to a second mare Evans gave 20 ounces of blood, drawn from the jugular vein of the same horse as that from which the blood was taken for the preceding experiment. On the morning of the 6th of October, with a temperature of 103° F. (39.4° C.), the blood presented many parasites, but not swarming as in the last case. The latent period extended from the morning of the 30th of September to that of the 6th of October, or 6 days.

"(*b*) *By giving small repeated quantities of soiled blood in water.*—As no previous researches have been conducted with small quantities of soiled blood in water, it was decided to endeavor to produce the disease in a somewhat similar manner to that in which it is naturally contracted. With this end in view, a strong healthy Australian gelding was obtained, sixteen years old and in good condition, to which small quantities of blood mixed with a large bulk of water were to be given at short intervals. Accordingly on the 4th of May, 1891, 4 minims (0.25 c. c.) of blood (swarming with the surra hematozoon) mixed with 1 gallon of fresh water, were given to the animal to drink. Up to the 9th no change had taken place in the animal's condition, and on this date 8 minims (0.53 c. c.) of blood containing numerous hematozoa were given in the same way. On the 10th and 11th the animal showed no change. On the latter date 6 minims (0.4 c. c.) of blood containing the surra hematozoon were given in a quart of water. On the 12th a few small petechiæ were noticed on the membrane nictitantes. Up to the 24th, with the exception of a slight indisposition on the 18th, which rapidly passed off, no symptoms of disease were noticed. On the 24th the animal received in water 8 minims (0.53 c. c.) of blood containing very numerous hematozoa; no change of any importance was noticed up to the 6th of June, and on that date the animal received in water 8 minims of blood containing numerous hematozoa. There was no change on the 14th of June, when 30 minims (2 c. c.) of blood containing very numerous hematozoa were given in 3 quarts of water. On the 16th no change having taken place, 10 minims (0.66 c. c.) of blood swarming with hematozoa were given. On the 17th 25 minims (1.6 c. c.), taken from horse No. 23 suffering from surra, but from which the hematozoon was absent, were given in a gallon of water. From this date to the 28th of June no change was noticed. On the latter date 200 minims (13.3 c. c.) of blood, containing very numerous hematozoa were administered in a bucketful of water. From this date (June 28) up to September 1 absolutely no symptom of disease was noticed; but from the 1st until the 6th of September there was a very slight disturbance of temperature, which, however, remained normal. On the morning of the 11th of September the temperature had risen to 39.4° C. and numerous hematozoa were observed in the blood.

"Thus it will be seen that from the first exhibition to the animal of the soiled surra blood on May 4, 1891, until the last on the 28th of June, a period of 55 days had elapsed; and from the exhibition of the last 200 minims, until the first appearance of the hematozoon in the blood, 75 days; or from first to last, 130 days.

"(III.) THE LATENT PERIOD WHEN THE FLUID USED FOR INOCULATION IS DRAWN ANTE- OR POSTMORTEM FROM THE ANIMAL AFFECTED WITH SURRA.

"*Antemortem.*

I. *Blood taken during a paroxysm—*

(*a*) *By gastric ingestion.*—Horse No. 20: 200 minims containing very numerous hematozoa. Period of incubation from the date of the last administration, 75 days.

(*b*) *By direct injection into the general circulation.*—Horse No. 15: 0.8 c. c. containing numerous hematozoa, 6 days. Horse No. 14: 0.7 c. c. containing numerous hematozoa, 5 days.

(*c*) *By subcutaneous injection.*—Horse No. 5: 3 c. c. containing very numerous hematozoa, 4 days. Horse No. 8: 1 c. c. containing very numerous hematozoa, 5 days. Horse No. 22: 1 c. c. containing very numerous hematozoa, 4 days. Horse No. 4: 1 c. c. containing few hematozoa, 8 days. Horse No. 30: 1 c. c. containing few hematozoa, 7 days. Horse No. 29: 0.8 c. c. containing few hematozoa, 7 days. Horse No. 59: 0.5 c. c. containing numerous hematozoa, 5 days. Horse No. 64: 0.5 c. c. containing few hematozoa, 7 days. Horse No. 12: 0.13 c. c. (2 minims) numerous hematozoa, 6 days. Horse No. 54: 0.1 c. c. containing swarms of hematozoa, 4 days. Horse No. 55: 0.1 c. c. containing swarms of hematozoa, 7 days. Horse No. 24: a fraction of 1 min[1]m, very numerous hematozoa, 7 days.

II. *Blood taken during an intermission—*

(*a*) *By subcutaneous injection.*—Horse No. 13: 1 c. c. hematozoon absent from the blood, 8 days. Horse No. 21: 1 c. c. hematozoon absent from the blood, 8 days. Horse No. 48: 0.5 c. c. hematozoon absent from the blood, 10 days.

"*Postmortem.*

I. *Blood removed from the heart or great vessels—*

(*a*) *By subcutaneous injection.*—Horse No. 27 inoculated with 2 c. c. blood taken 16 hours postmortem, from which the hematozoon was absent, but very numerous antemortem. Latent period 11 days. Horse No. 11 inoculated with 1 c. c. blood taken 10½ hours postmortem, from which the hematozoon was absent, but very numerous antemortem. Latent period 11 days. Horse No. 18 inoculated with 2 c. c. blood taken 10 hours postmortem, from which the hematozoon was absent, but numerous antemortem. Latent period 13 days. Horse No. 19 inoculated with 2 c. c. blood taken 10 hours postmortem, from which the hematozoon was absent, but numerous antemortem. Latent period 9 days. Horse No. 32 inoculated with 0.3 c. c. blood taken 8½ hours postmortem, from which the hematozoon was absent, but very numerous antemortem. Latent period 9 days. Horse No. 46 inoculated with 1 c. c. blood taken 8½ hours postmortem, from which the hematozoon was absent, but very numerous antemortem. Latent period 8 days. Horse No. 23 inoculated with 1 c. c. blood taken 5½ hours postmortem, from which the hematozoon was absent, but swarming antemortem. Latent period 8 days. Horse No. 58 inoculated with 1 c. c. blood taken 5 hours postmortem, from which the hematozoon was absent, but swarming antemortem. Latent period 9 days.

II. *Blood serum from the large vessels—*

(*a*) *By subcutaneous injection.*—Horse No. 7 inoculated with 1 c. c. serum taken 2 hours postmortem, the hematozoon was absent, but was numerous in the blood antemortem. Latent period 8 days.

"*Antemortem.*

Tunica vaginalis testis fluid and blood.—Horse No. 33 inoculated with 1 c. c. of fluid from the tunica vaginalis testis of goat, in which the hematozoa were numerous. Latent period 5 days. Horse No. 34 inoculated with 1 c. c. of blood from No. 33, antemortem containing numerous hematozoa. Latent period 13 days.

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"*Postmortem.*

I. *Blood removed from the heart or great vessels.*—Horse No. 38 inoculated with 1 c. c. of blood taken 9½ hours postmortem, from which the hematozoon was absent, but very numerous antemortem. Latent period 9 days. Horse No. 41 inoculated with 1 c. c. of blood taken 9½ hours postmortem from case No. 40, from which the hematozoon was absent, but very numerous antemortem. Latent period 7 days. Horse No. 40 inoculated with 0.6 c. c. of blood taken 1½ hours postmortem from case No. 34, from which the hematozoon was absent, but very numerous antemortem. Latent period 6 days. Horse No. 31 inoculated with 0.3 c. c. of blood taken 8 hours postmortem from case No. 33, from which the hematozoon was absent, but swarming antemortem. Latent period 9 days.

II. *Blood serum removed from the large vessels.*—Horse No. 50 inoculated with 2 c. c. of blood serum taken 45 minutes postmortem from case No. 38, from which the hematozoon was absent, but swarming antemortem. Latent period 9 days.

"INOCULATION OF OTHER ANIMALS THAN HORSES.

"*Antemortem.*

I. *Blood taken during a paroxysm from horses—*

(*a*) *By subcutaneous injection.* Bull: 1.7 c. c. containing very numerous hematozoa. Latent period 7 days. Sheep: 0.8 c. c. containing a few hematozoa, and with 1 c. c. containing a few hematozoa 14 days later, no organism found in the blood, but they were found on the fifty-ninth day in the fluid of the tunica vaginalis testis. Goat: 0.5 c. c. containing swarms of hematozoa. Latent period was 7 days. Rabbits: 0.3 c. c. containing very numerous hematozoa, latent period 5 days; 0.3 c. c. containing very numerous hematozoa, latent period 9 days. Guinea pigs: 1 c. c. containing very numerous hematozoa, latent period 12 days. Guinea pigs: 1 c. c. containing very numerous hematozoa, latent period 9 days. Guinea pigs: 0.5 c. c. containing very numerous hematozoa. This was a pregnant doe, and the latent period was 7 days, showing that pregnancy predisposes. Rats (*Mus decumanus*): 0.2 c. c. containing very numerous hematozoa. Latent period, 1 day. Rats (*Mus decumanus*): 0.1 c. c. containing a few hematozoa. Latent period, 2 days. Rats (*Mus decumanus*): 0.1 c. c. containing a few hematozoa. Latent period 2 days. Rats (*Nesokia providens*): 0.2 c. c. containing numerous hematozoa. Latent period, 2 days. Rats (*Nesokia providens*): 0.2 c. c. containing numerous hematozoa. Latent period, 5 days. Rats (*Nesokia providens*): 0.2 c. c. containing numerous hematozoa. Latent period, 5 days.

"*Postmortem.*

I. *Blood and other fluids removed from the body—*

(*a*) *By subcutaneous inoculation.* Goat No. 3 inoculated with 1 c. c. blood taken 5½ hours postmortem, from which the hematozoon was absent, but swarming antemortem. Latent period, 6 days. Guinea pig inoculated with 0.4 c. c. cerebrospinal fluid 2 hours postmortem, hematozoa absent, but very numerous in the blood antemortem. Latent period, 11 days. Guinea pig inoculated with 1 c. c. pericardial fluid 13 hours postmortem, hematozoa absent, but swarming in the blood antemortem. Latent period, 10 days. Guinea pig inoculated with 1 c. c. pericardial fluid 13 hours postmortem, hematozoa absent, but swarming in the blood antemortem. Latent period, 10 days." (Lingard, 1893, pp. 55–61.)

STAGES AND DURATION.

The duration of surra varies with the species of animals attacked, their age and general condition, but sex has no influence. According to Griffith Evans (1881, p. 4), the records of the Fourth Punjab Cavalry show an average duration of 43 days after admission on the sick list. Burke (1888a, p. 9; 1891, p. 268) gives the average (taken from Evans) as probably not less than 2 months. According to Burke (1897, p. 192), naturally weak animals succumb more quickly than strong ones; in some cases the course is very rapid, and may be (1891, p. 268; 1892, p. 192) less than 1 to 2 weeks. Nariman & Vaz (1893, p. 403) describe the animals as dying by inches. The Veterinary Journal, London (1896, p. 179), gives the duration as proportionate to the animal's age, constitution, and condition; young horses may pass through seven or nine paroxysms, while old, worn-out animals may succumb quickly. Pease (1897, p. 560) states that nearly all cases take a month or more to kill, and Hayes (1898, p. 481) quotes Gunn as authority for 52 days as the average duration.

In discussing the subject of stages and duration, Lingard (1893, p. 73) says:

"*Stages.*—The fever of surra, as before mentioned, varies to such an extent in different cases that it is impossible to group any number of them under any one system of description as regards the stages of the disease. The insidious nature of the onset in the naturally contracted disease, devoid of symptoms during a considerable period, renders it impossible to recognize it until such time as the organism appears in the blood. Consequently little is known concerning the latent period and stage of invasion, and in such cases, when untreated, the fever is of a continued type, followed by one or more intermissions at long but irregular intervals.

"In this disease, when artificially produced, the majority follow the type before mentioned, but a number present a peculiar series of symptoms, reminding one of relapsing fever in man. But here again certain variations are observed. Such cases as Nos. 20, 38, 50, 54, however, lend themselves to description, which will be made clear on reference to the charts, and may be described as presenting well-marked stages, viz:

"I. The period of incubation, or latent period.

"II. The primary paroxysm.

"III. The intermission.

"IV. The relapse.

"V. Death.

"The paroxysms, as in relapsing fever in man, are again subdivisible into the accession, the pyrexial stage, and the crisis. But in all cases of surra we find periods during which the hematozoon is present, and others during which it is absent. The only system, therefore, under which all cases can be grouped is that having for its basis the presence and absence of the organism; the former we term the paroxysm and the latter the period of intermission."

THE COAT.

The coat of affected animals is described as staring. (Griffith Evans, 1881, p. 2.)

PERSPIRATION.

This symptom is entirely absent during the whole course of the disease, until just before death, when, as a rule, profuse sweating occurs. (Lingard, 1893, p. 68.)

ERUPTION, URTICARIA, EDEMA.

Referring to eruption and edema, Lingard (1893, p. 64) says.

"*Eruption.*—In the majority of cases, no eruption of any kind occurs during the whole duration of the disease. Steel, however, noted in mules an eruption of spots on the skin of the muzzle, resembling in its essential nature those he had observed on the mouth and nostrils. In the course of this investigation we have observed a number of cases of urticaria, appearing somewhat suddenly and, as a rule, disappearing after a few hours. The eruption has been either general or localized in character, and could be conveniently placed under several of the different classifications, viz: The affection which passes away in a few hours (*Urticaria ephemera*), or within a few days (*U. evanida*), or the form which is either preceded or accompanied by fever (*U. febrilis*), and lastly the (*U. nodosa seu tuberosa*), which is characterized by the appearance of nodosities of some size.

"If we further examine as to the dates on which the eruption occurred in the different cases, we find that in the naturally contracted ones (horses Nos. 65 and 73) it occurred on the first day of the disease, and was of the form known as *Urticaria evanida;* in horse No. 71 it appeared on the sixteenth day, and was an *Urticaria ephemera;* that in horse No. 3, on the eighteenth day was an *U. ephemera* also; and in horse No. 72, on the twenty-second day, *U. evanida;* in horse No. 20, which acquired the disease by gastric indigestion, it appeared on the ninth day of the disease, and was an *U. ephemera;* in the horses Nos. 22 and 6, it appeared in the former on the eleventh and in the latter on the twelfth day of the disease, both *U. ephemera.* And in the animals inoculated with the blood of the horses through the goat: In No. 41 the eruption appeared in 18 hours after inoculation (*U. evanida*), in No. 40 the eruption appeared in 68 hours after inoculation (*U. evanida*), in No. 30 the eruption appeared in 48 hours after the appearance of the hematozoon in the blood (*U. ephemera*), in No. 50 the eruption appeared in 48 hours after the appearance of the hematozoon in the blood (*U. ephemera*)." (Lingard, 1893, p. 66.)

Consequently it will be seen that the eruption of urticaria may take place at any time from 18 hours after inoculation until the twenty-second day after the appearance of the hematozoon in the blood.

"*Swelling and edema at the seat of inoculation in experimental cases.*—When an animal has been subcutaneously inoculated with the soiled blood or other fluids containing the 'materies morbi' of 'surra,' considerable swelling, as a general rule, follows at the seat of such injection. If we analyze this symptom we find that on the day following the operation a small raised, somewhat circular tumor appears, about 1 inch in diameter, while in some cases, especially when the blood used was obtained some hours postmortem, the measurements greatly exceed this, as in cases 27 and 41. On the third day the swelling has increased in dimensions, and probably measures from 1½ to 2 inches in diameter; it now appears tense, and is tender on manipulation. By the fourth day a still further augmentation in size, etc., has occurred, and from this date until the appearance of the hematozoon in the blood of the general circulation, the swelling, tension, and tenderness of the part may go on steadily increasing, or, as sometimes happens, it remains stationary. At this time it will be found that if the tumor be firmly grasped by the hand, one can

readily lift it up from the subcutaneous structure, proving that it only involves the skin. A point of great interest and a symptom of the greatest clinical value occurs at the time of the organism leaving the seat of the swelling—for the hematozoon has been proved, as in horse No. 8, to be present in the fluid of the tumor 3 days after inoculation, and 2 days before being discovered in the blood of the general circulation; and, in the case of horse No. 54, 24 hours before its first appearance in the blood—in that the raised tumor, which was previously tense and so tender that the animal flinched whenever touched, now suddenly becomes soft and flaccid, and manipulation of the parts can be carried on with little or no notice being taken by the inoculated animal.

"It will, therefore, be recognized that from the time of inoculation until the organism leaves the tumor for the general circulation, or, in other words, during the latent period of inoculation, this disease is purely a localized affection, and can therefore be treated either by excision or by the injection of antiseptics at the seat of inoculation.

"In 1 case only out of 22, which contracted the disease by experimental means, was the swelling absent from the seat of inoculation, but in this from first to last, during a period of 9 days, no swelling or thickening of the integument could be felt. The shortest time noted in horses during which the swelling attained its maximum, and commenced to decrease in size was 96 hours, and the longest 12 days, the average length of 21 cases being 6.7 days. Within a very few days after the appearance of the hematozoon in the blood, the tumor has usually decreased considerably in size, and after a fortnight only a slight thickening of the skin can be noticed on careful examination of the part." (Lingard, 1893, pp. 66–67.)

According to the Veterinary Journal, London (1896, p. 177), with the rise in temperature there is usually an attack of local or general urticaria. There is generally some edema of the limbs, about the fetlocks and hocks, and beneath the belly, chest, and sheath.

In a large proportion of the cases the legs are swollen, and when pressed with the fingers they pit. Sooner or later a similar swelling is found between the fore legs of mares or at the sheath of horses, and the animal is dropsical (Griffith Evans, 1881, p. 3); (p. 4) the progress is variable, often marked by an increase of dropsical swelling which, however, sometimes subsides, again returning worse than before. Evans has seen some cases, in the last stage, in which there was no swelling, although it had been there before.

Nariman & Vaz (1893, p. 404) refer to an edema of an evanescent nature on the hind limbs, beginning at the fetlock and extending upward; edema of the sheath and testicles extending slightly to the lower part of the abdomen; later it becomes more prominent on the hind limbs and is often seen on the fore limbs, while the edema of the abdomen extends to the chest and breast.

Dropsy is frequent (Steel, 1886a, p. 169).

SWELLING OF THE SUBMAXILLARY GLANDS.

The submaxillary glands sometimes become enlarged. Griffith Evans (1881, p. 3) says that in a small proportion of the cases the submaxillary glands are enlarged and tender; in a few cases (Griffith

Evans, 1881, p. 4) the swelling of the submaxillary glands develops into an abscess, with a gluey mucous discharge from the nose. No other swellings are noticed and no ulceration of the nose nor tubercle of the lungs.

EMACIATION.

According to Griffith Evans (1881, p. 4), the most constant and invariable symptom in the progress of the disease is the wasting away of the flesh; and this appears the more remarkable, considering how much the patient eats and apparently with good appetite. This wasting, or withering away, goes on more rapidly in some cases than in others. Several authors refer to the patients as consisting only of skin and bones and as presenting a most pitiful appearance.

Lingard (1893, p. 80) says that the body is usually much emaciated, the word "surra" implying "rot" or "dry rot;" and the disease is characterized by a progressive loss of flesh, or withering of the tissues. In some cases, however, when the animal is carried off rapidly, owing to the severity of the fever or from other causes, it may be in fairly good condition.

EYES.

Lachrymation.—This at first is slight, but in some animals rapidly increases in amount until it becomes profuse. At a varying period in the disease there appears at the inner canthus a semigelatinous secretion, which may become mucopurulent in character, and during the presence of the hematozoon in large numbers in the blood, slight hemorrhages take place from the conjunctival membranes, and the secretion becomes blood-stained. At these times it always contains the hematozoon in varying numbers. (Lingard, 1893, p. 72.)

Griffith Evans (1881, p. 3) remarks that the eyes are "weeping," while the Veterinary Journal, London (1896, p. 177), states that the eyelids are swollen, and perhaps conjunctivitis may be present. Lachrymation may be profuse toward the end of the disease.

Petechiæ.—If the eyelids are inverted (Griffith Evans, 1881, p. 3) the conjunctival membrane is seen to be of a decidedly yellow color, often a dirty yellow, with claret-colored spots (petechiæ) on the eyelids, or, as is most common, on the membrana nictitans at the inner corner of the eye. According to Steel (1886a, p. 169), a characteristic feature of the disease, and one which seems to be in direct and close relations with the activity of the parasites in the blood, is the occurrence of "crops" of petechiæ, especially detectable on the conjunctivæ; they seem to occur when the parasites have attained their maximum activity and frequency, and when the temperature begins to fall.

This is not the only disease in which petechiæ or more extensive extravasations occur, for these are usually present in anthrax, so-called

bilious fever, petechial fever, and other diseases; also when an animal is suffering from the presence of small nematodes in the general circulation. In surra the petechiæ on the conjunctival membranes are specially prone to invade the membrana nictitans of the Equidæ, and frequently attain a large size, becoming relatively extensive extravasations. They may precede the discovery of the hematozoon, but, as a rule, are found shortly after the first appearance of the organism in the blood, and commence to fade immediately when it disappears; and, as each successive brood of the hematozoon makes its debut, a fresh crop of petechiæ appears on the membranes, and it often happens that a second series of petechiæ is present before the first has completely faded. (Lingard, 1893, p. 72.)

Later, Lingard (1899, p. 26) says that the conjunctivæ are frequently stained with yellow, and there are successive crops of subconjunctival petechiæ.

Hemorrhages into the anterior chamber occasionally occur, but the amount of blood is generally small. The color at first is red, and after a period of 24 hours or more the coloring matter is absorbed, leaving the extravasated mass either of a whitish hue or somewhat yellow in the case of an animal in which the membranes are already tinged that color. As a rule, no absorption of the extravasated material takes place, owing to the short period which elapses between the occurrence of it and death. (Lingard, 1893, p. 72.)

The Veterinary Journal, London (1896, p. 177), also records that slight hemorrhages occasionally take place into the anterior chamber of the eye, followed by opacity.

Opacity of the cornea.—Complete opacity is of rare occurrence, but toward the termination of a long case a slight milkiness of the cornea may be observed, and is not at all infrequent. Lingard has, however, seen one case in an Arabian horse, where complete opacity occurred a few days before death, and therefore blindness supervened. (Lingard, 1893, p. 72.)

Hematozoa.—On several occasions *Trypanosoma* have been observed in the fluid of the anterior chamber and in the vitreous humor. (Lingard, 1893, p. 72.)

NOSE.

Catarrhal discharge.—There are slight catarrhal symptoms, the eyes weeping; and often there is a discharge from the nose of mucus more or less tinged with yellow (Griffith Evans, 1881, p. 3). In later stages there may be gelatinous or purulent discharge from the eyes and at times from the nostrils, with fullness and enlargement of the submaxillary glands. According to Lingard (1893, p. 73), there is often a slight discharge of clear fluid from one or both nostrils during the second week after invasion. This is the result of excessive lachry-

mation, which appears to a greater or less extent in all surra animals. The fluid passes down the lachrymal duct into the nostrils, and at a later date a clear albuminous fluid is noticed running from one or both of the latter. This comes from the nasal passages proper, and is the result of an inflammatory condition of the membrane covering the turbinated bones. This fluid after a time becomes mucopurulent in character, and another symptom is to be noticed, namely, snuffling-breathing, which points to the situation and cause of the discharge. If one could examine at this stage the mucous membrane covering the turbinated bones, it would be found to present a deep-red or purple color, from the highly congested condition of the capillary vessels, and to be considerably increased in thickness. The Veterinary Journal, London (1896, pp. 177–178), also refers to signs of catarrh, with a yellow-tinged discharge from the nostrils. Lingard (1899, p. 29) again refers to slight mucous discharge from the nostrils and eyes.

Petechiæ and injection of the nasal septum.—The presence of minute petechiæ on the walls of the *septum nasi* is of very constant occurrence. The mucous membrane covering the cartilage is tumefied, and presents small red points from which minute drops of blood exude. These points appear as if they might have been produced by punctures of a large number of needles, so minute are they. This condition does not show itself until the animal has been ill for some days, and then it might be easily overlooked without a certain amount of care in observation. (Lingard, 1893, p. 72.)

Ulceration inside the nostrils.—One observer (Steel) mentions the occasional occurrence in mules of ulcers on the Schneiderian membrane, when the epithelial débris remains as a yellow scab for a day or two and is then washed away by mucus. The earliest appearance of these ulcers in the nose is as though the membrane had been grazed and blood were slowly oozing. These ulcers rapidly disappear and the general character of the membrane becomes normal. Lingard has not observed these, however, in the cases of naturally acquired surra or in the inoculated cases. (Lingard, 1893, p. 72.)

The Veterinary Journal, London (1896, p. 177), also mentions that ulcers occasionally form on the Schneiderian membrane.

Thickening of the Schneiderian membrane.—This condition is frequently met, more especially at an advanced stage of the disease. By the entrance of air into the nasal passages and by its exit therefrom, a peculiar sound is produced, which is due to the swollen condition of the mucous membrane lining the cavities. On examination, a congested and arborescent condition of the vessels is found, particularly well marked on the upper part of the nasal septum. (Lingard, 1893, pp. 72–73.)

Epistaxis.—Lingard (1893, p. 73) observed bleeding from the nose once out of some 72 cases of surra. It occurred toward the termina-

tion of the disease. No great amount of blood was lost at one time, but the attacks were characteristically recurrent, occurring principally during the early morning.

MOUTH AND TONGUE.

When the disease has fairly set in, the tongue and membranes of the mouth become extremely pale, and later assume a yellow tinge. Some observers have noticed small symmetrically arranged ulcers in pairs on the tip of the tongue, and sometimes a degeneration of the epithelium, which at a later date separates from the deeper part of the membrane, leaving superficial circumscribed ulcers. (Lingard, 1893, pp. 69–70.)

VULVA, VAGINA, AND PENIS.

If the labia are parted it will be seen that the mucous membrane of the vagina is decidedly yellow, with petechiæ even more marked than in the eye (Griffith Evans, 1881, p. 3). When the petechiæ are well marked on the vulvæ of mares they are very suggestive of surra.

According to Lingard (1893, p. 78), serous effusion beneath the vulval membranes is not infrequent in mares, and Steel observes that "the irritation of these parts is, however, shown by frequent symptoms of 'horsing.' Indeed, in mares there is almost always in this disease a little reddish brown fluid dried about the external generative orifice, which discharge persists throughout the attack. The parallel to this sexual phenomenon of mares is seen in male animals, as frequent and quite uncalled-for erections of the penis, which may be due to irritation of the erection center in the cord, but possibly, also, is associated with the formation of clots in the erectile structure of the penis, which organ latterly in the attack remains permanently slightly protruded and turgid, or there may be embolic plugging in the vessels." (Lingard, 1893, p. 78.)

MUCOUS MEMBRANES.

The mucous membranes become yellow and petechiæ occur on one or the other; but these are not persistent, generally leaving entirely during the intermittent stage of the fever. (Vet. J., Lond., 1896, p. 177.) (See also "Tongue," p. 67; "Eyes," p. 64; "Nose," p. 65; "Vulva, vagina, and penis," p. 67.)

EXCRETIONS AND SECRETIONS.

URINE.

Quantity.—Griffith Evans (1881, p. 4) says that in some advanced stages the urine is passed more frequently and appears to be much more in quantity than normal, while Ranking (1891a, p. 399) describes

the urine as abundant, and Nariman & Vaz (1893, p. 404) report that staling is frequent. According to Lingard (1893, p. 71), the quantity of urine in the early stage of the disease does not appear to vary to any great extent from that in health, but toward the end more is passed; but this must naturally depend to a large extent upon the amount of water taken by the animal during the 24 hours and upon the season of the year.

Color.—The urine of the horse in health when the animal is allowed to stand after exercise until cool, is turbid and yellow in color; carbonates of calcium and magnesium are precipitated. After inoculation with surra, the urine remains turbid, and becomes orange in color, and later of a dingy green or greenish yellow. If the kidneys become affected, the quantity secreted is diminished, the density of the fluid is increased, and the color changed to that of cream or a light-yellow ocher; the latter color lasts for a few days only, 4 at the most, and then the fluid becomes a greenish yellow or dirty orange. In some horses the fluid passed is very viscid, but not in all; however, in the case of mares it is usually so from the first, and remains so, as long as the urine is alkaline, but as soon as the fluid becomes acid, the viscidity as a rule diminishes. (Lingard, 1893, p. 71.)

According to Griffith Evans (1881, p. 3) the urine is highly colored (also Nariman & Vaz, 1893, p. 404), but may later become normal. The Veterinary Journal, London (1896, p. 178), states that the urine becomes viscid, dark yellow, orange, or orange green. In Burma (George H. Evans, 1899, p. 41) the urine of surra patients varies a great deal; sometimes it is viscid, other times not; in color, it varies from a reddish to a greenish yellow.

Bile pigments are frequently seen (Lingard, 1893, p. 71). Burke (1891, p. 268; 1897, p. 191) says that the urine contains much hemoglobin, which is set free by the destruction of the red blood corpuscles, and Ranking (1891a, p. 399) reports that in one fatal case a pigment was found "which was no doubt urohematoporphyrin," but no spectroscopic examination was made. According to the Veterinary Journal, London (1896, p. 178), blood is frequently present, while George H. Evans (1899, p. 41) says that blood is common.

Odor.—Lingard (1899, p. 24), in referring to surra among camels, says that the diagnosis is most surely made from the smell of the urine, which becomes very offensive.

Specific gravity.—The range observed in the specific gravity is very considerable, and in the same animal may differ widely from day to day. In the case of horse No. 72 it was as low as 1,004 on the 19th of October, 1892, and rose to 1,034 on the 20th, and to 1,046 on the 23d; the highest registered in any case was 1,055 (horse No. 26), 31st of October, 1891. (Lingard, 1893, p. 71.)

Reaction. The reaction of the urine of horses is always alkaline

in health, but varies according to the food given. In India the urine of animals fed upon oats is acid in reaction, while, on the contrary, when supplied with grass and gram the reaction is alkaline. When a horse is the subject of surra, especially in long-protracted cases, the urine remains alkaline until some 7 or 8 days before death, when it is found to change and become, respectively, feebly alkaline, at the expense of the carbonates of calcium and magnesium, neutral on the following day, then slightly acid, and finally strongly acid; and this acid condition of the secretion is maintained until death takes place; in some cases it lasts for as long as 6 days. (Lingard, 1893, p. 71.)

Nariman & Vaz (1893, p. 404) give the reaction as acid in advanced stages of the disease. In Burma (George H. Evans, 1899, p. 41) it is, as a rule, alkaline, but toward the close of the disease the reaction is often slightly or distinctly acid.

Urea.—Lingard (1893, p. 71) states that the quantity of urea passed during the paroxysms and apyrexial stages is at present under investigation. It appears, however, that the amount of urea excreted is increased to a considerable extent immediately after the parasite appears in the blood. During the paroxysms the amount undergoes a slight decrease, rising again during the absence of the hematozoon from the blood. It is a point of considerable interest that the maximum excretion of urea generally takes place during the second intermission, and after this period gradually diminishes with perhaps a slight occasional rise until the animal succumbs. This question, however, requires further investigation, and is now being carefully worked out.

Uric acid.—Uric acid is not increased in the horse, but in the ass it has been found to be present previous to inoculation, and to be absent after the appearance of the hematozoon in the blood. (Lingard, 1893, p. 71.)

Phosphates.—Phosphates are occasionally present, but in the great majority of cases are absent in any appreciable amount. (Lingard, 1893, p. 71.)

Albumen.—This does not appear until some little time after the first appearance of the hematozoon in the blood, and then only in small quantities, unless the animal develops signs of the kidneys being specially affected. In case No. 38 the animal presented well-marked symptoms of the kidneys having become involved. On examination of the urine, epithelium, blood, and granular casts were found daily; so that evidently the animal was the subject of an acute desquamative nephritis. (Lingard, 1893, p. 71.)

According to Ranking (1891, p. 399), Burke (1891, p. 268; 1897, p. 191), and the Veterinary Journal, London (1896, p. 178), the urine is frequently or usualiy albuminous. Nariman & Vaz (1893, p. 404) say that "later on" the urine is highly surcharged with albumen; while

according to George H. Evans (1899, p. 41), in some cases of surra in Burma, small quantities of albumen may be present.

Casts.—Griffith Evans (1881, p. 5) failed to find casts, but George H. Evans (1899, p. 41) reports that granular-looking casts are common.

Sugar.—Sugar was not detected in a single case. (Lingard, 1893, p. 71.)

Parasites.—Parasites were not detected in the urine. (George H. Evans, 1899, p. 41.)

Retention and incontinence.—Retention and incontinence have not been observed in horses. (Lingard, 1893, p. 71.)

FECES.

Griffith Evans (1881, p. 3) did not find the dung abnormal in any case. He was told by the salootri, who laid great emphasis upon it, that the dung balls are sometimes coated with mucus, having red patches. "He showed me one of these; it was what we often find in health." Evans mentions, however, that in a few days after admission on the sick list the dung becomes normal. According to Lingard (1893, p. 70), the rule is that the bowels are constipated, although diarrhea coming on late in the disease is an occasional symptom. The stools retain for some time their natural color and consistency, but frequently become lighter than normal. At a later period they are usually coated with a layer of mucus of a light-brown color, the dung balls presenting a glazed appearance, or at times they may be tinged with blood. On microscopic examination of the brown mucus it is found to contain epithelium and a large number of colorless octohedral or polyhedral crystals. Toward the termination of a case, occasionally the dung becomes semisolid or pultaceous in consistency, and then emits a very foul odor.

Nariman & Vaz (1893, p. 405) refer to the feces in later stages as being "stinking and soft," and the Veterinary Journal, London (1896, p. 177), says that feces are, as a rule, normal throughout the attack, but occasionally there are signs of constipation, and at the termination of the disease there may be diarrhea.

In Burma, constipation is the rule, diarrhea the exception; dung is at first natural; later it is of a light-brown color, and toward the end of the disease it is frequently pultaceous and possesses a foul odor (George H. Evans, 1899, p. 41).

ACTION AND PARALYSIS.

According to Griffith Evans (1881, p. 2) the action is sluggish, occasionally with stumbling on the fore legs or dragging the hind legs on the ground. Burke (1891, p. 269; 1897, p. 191) says there is both an acute and a chronic form of paralysis—stringhalt, muscular tremors, crossing of legs, etc.; (1891, p. 271) in some cases of paralysis of the

hind quarters, or other well-marked nervous symptoms, the gray matter of the cord generally shows blood extravasations and staining of the nerve cells, but beyond a tendency to congestion and occasional blood extravasation no lesions are usually discovered in the nervous system; (1897, p. 191) the symptoms described (stringhalt, muscular tremors, crossing of the legs) are due to some effusion of blood on the spinal cord or on particular nerves. Dragging of the hind toes is the result of muscular paralysis.

According to Nariman & Vaz (1893, pp. 404, 405) there is a dragging of the hind limbs and flinching on the slightest pressure over the loins; the animal begins to roll, is very unsteady in his gait, and prefers to lie down; soon the belly is tucked up; there is inability to rise; constant shivering followed by jugular pulsations, groaning, and death.

The Veterinary Journal, London (1896, p. 181), states that there is occasionally a considerable increase of fluid on the spinal cord about the lumbar region, which would probably account for the symptoms of paralysis sometimes present.

APPETITE AND THIRST.

Griffith Evans (1881, p. 2) describes the thirst as more or less abnormal, the appetite as capricious; (p. 3) later, the animal may refuse food, and there is great thirst. According to Steel (1886a, p. 169), in some cases the animals at last drop down and die suddenly, perhaps when they are eating and enjoying their food; in other cases they linger for days after they are down, too weak to rise, or too weak to stand after they are helped up; they may go on eating all the grass they get and much of the grain, until they die; it is remarkable how the animal in a state of semicoma will continue to eat grass almost without ceasing. Exceptions to this rule occur, for Lingard (1899, p. 61) examined an outbreak in which the most marked symptoms were *loss* of appetite, fever, emaciation, etc. Burke (1891, p. 269) says the appetite is greedy, or even voracious (1897, p. 191), but the debility appears progressive; the animal may continue to feed to the last. According to Nariman & Vaz (1893, p. 404), the appetite and thirst are hardly affected, but in many cases are abnormal. Later the appetite may be poor, the animal eating only a little lucern and grain; the thirst, however, is very great and there is profuse staling. The Veterinary Journal, London (1896, p. 177), says that the animals lose strength and condition, but the appetite remains good, except when the fever is very high, and even then green forage is eaten freely. The animals suffer greatly from thirst, and advantage is taken of this in administering medicine. Burke (1897, p. 191) states that the appetite is as good as in health. Lingard (1899, p. 60; 1900, p. 341) says that the appetite is ravenous. While in the horse the desire for food (also 1893, p. 70) usually ceases with supervention of fever, this disease is an extraordinary exception

to the rule. In most cases, from the very onset of the disease until death, which may occur weeks or even months later, the animal may never cease to eat all the food placed before it, and in numerous cases under Lingard's observation the bedding was devoured during the night, the temperature at that time registering 41.2° C. (106.1° F.) or even as high as 42° C. (107.6° F.).

GURGLING.

From a very early period gurgling is present. In fact, it would not be overstepping the truth to say that this is a marked symptom in every case of this disease. It is frequently so pronounced as to be audible at some distance from the animal. (Lingard, 1893, p. 70.)

METEORISM, OR TYMPANITIS.

Meteorism is an occasional symptom which at times becomes sufficiently severe to require special treatment, but a brisk saline purgative is usually found to give great relief, though in some instances the symptom persists in spite of treatment. (Lingard, 1893, p. 70.)

RESPIRATION AND BREATH.

The respiratory movements are usually quickened from the first, sometimes out of all proportion to the pulse, so that they reach 60 to 65 in the minute, quite independent of any pulmonary complication. The respirations frequently appear to be entirely abdominal, and in these cases the ribs are not seen to move at all. It has frequently been noted that animals present a peculiar form of breathing when otherwise they appear fairly well, namely, eight or nine shallow respirations are immediately followed by a deep sonorous one, and this condition may last for several hours. Cheyne-Stokes* respiration was noted in one animal (No. 37) shortly before death. In this case the animal had, during the last few weeks of its life, suffered from severe kidney complications. (Lingard, 1893, p. 69.)

During the greater part of the period the disease lasts the breath is free from odor, but in the majority of cases, toward its last phases, it becomes very fetid, and in cases complicated with ozena; the mere name of ozena is sufficient to describe the offensiveness of the discharge. (Lingard, 1893, p. 69.)

According to Griffith Evans (1881, p. 3) the breath sometimes smells bad. Nariman & Vaz (1893, p. 404) state that respiration is quick and there is much panting on the slightest exertion, the latter symptom

*A peculiar type of breathing in which there is a rhythmic increase of the respirations up to a certain degree of rapidity, then gradually decreasing again to temporary cessation. This pause may be as long as half a minute. This form of respiration is most commonly seen in the late stages of tuberculous meningitis, but it may also be noted in apoplexy, fatty degeneration of the heart, and nephritis with uremia.

being well marked and often the first symptom to attract the owner's notice; they also refer (p. 405) to the breath as fetid in advanced stages of the disease. The Veterinary Journal, London (1896, p. 178), says that the respirations are usually proportionate to the amount of the fever, but there is seldom much distress, although the lungs are occasionally found more or less affected, and toward the end the breath becomes very fetid. (For a clinical chart of the respiration, according to Lingard (1893), the reader is referred to page 76, under "Temperature," p. 74.)

HEART ACTION AND PULSE.

Griffith Evans (1881, p. 3) speaks of the pulse as being elevated, but a few days after admission to the hospital it lowers; (p. 4) in the last stages of the disease there is much anemic palpitation of the heart and the sound may be heard a little distance off.

Lingard (1893, pp. 68–69), in discussing the pulse and heart action, says:

"*The pulse.*—This is accelerated; it ranges between 30 and 90, and may reach 120 just before death, but varies considerably in the different types of cases recognized in this disease, not only in frequency but in rhythm and force. At the commencement the pulse increases in frequency upon the first rise of temperature, and continues to do so as long as the temperature becomes elevated during the latent period of the disease. On the appearance of the organism in the blood the pulse may fall somewhat, but again rises and remains so during the paroxysm of fever until the first apyrexial period, when it again falls to normal or thereabouts. A repetition of the above is observed in each fever and fever-free period until toward the termination of the case by death, when the pulse increases in frequency, and at the time of death may attain 120 beats to the minute, or even more. It will be of interest to examine the charts of horses Nos. 472 and 356 as examples of a point brought out by Steel, that 'the tracing from the number of pulse beats resembles that from thermometer readings.' In nearly every case of surra, at one period or another, and usually during one of fever, the pulse presents unmistakable signs of irregularity or intermission. I have noticed from one complete intermission in twelve beats down to as many as one in four; but in most instances a few hours later, or on the following day, no trace of irregularity existed. During a period of fever the pulse may vary considerably in frequency, according to the elevation of the temperature, with or without intermissions. The blood vessel during this time feels round and dilated with a moderate tension, the access of the pulsation is sudden and of short duration and its subsidence abrupt, but is fairly easy of compression between the beats, the walls of the vessel feeling smooth and elastic. But a marked change appears during an apyrexial period, the frequency is diminished or normal; in many instances there is some irregularity, or the pulse intermits; the beat is weak and thready, the access being gradual, its duration long and the subsidence slow, and the vessel feels flat, or, at the most, only half distended with blood.

"When the disease has been running on for a variable period, there comes a time, only a few days before death, when continued fever, usually accompanied by daily remissions, takes the place of the former type. During this period the pulse is increased in frequency, 65 to 72 beats per minute, regular, but bounding, forcible and large, reminding one of the force of the pulse of aortic regurgitations, but in surra the impulse is not visible in the carotids or in the superficial arteries. At the time of

death the frequency of the pulse is greatly increased and may attain 120 or more beats per minute.

"*Action of the heart.*—As a rule there is nothing noticeable with regard to this organ until the disease is fairly advanced, when, after repeated attacks of fever, with the accompanying organisms in the blood, the animal becomes more and more dull and dejected in appearance. There is breathlessness on exertion, very often sleeplessness and inability to lie down, together with an incapacity for a sustained exertion. The heart's action then becomes exceedingly irritable, and at a later date, when the bounding pulse appears as a result of the condition of the organ, its action becomes violent and tumultuous, so that not only is the animal swayed backward and forward by it, but bystanders are able to hear the sounds at a distance of a few feet. At this time also jugular regurgitation is observed, and distention of the superficial veins of the body, particularly those of the head and the large external or subcutaneous thoracic vein, running from the flank toward the olecranon region."

For a clinical chart of the pulse, after Lingard (1893), see chart under "Temperature."

Nariman & Vaz (1893, p. 404) describe the pulse as frequent and soft. Later it becomes soft and irregular, often accompanied with palpitation of the heart. According to the Veterinary Journal, London (1896, p. 179), the heart action becomes irritable and (if the case is nearing a fatal termination) weak, with frequent and often distressful anemic palpitation.

TEMPERATURE.

Surra is characterized by an intermittent, remittent, and sometimes a relapsing type of fever, which continues for varying periods, from a day to months, according to the species and the animals attacked (Lingard, 1893, p. 1). In discussing the temperature more in detail Lingard (1893, pp. 67–68) says:

"In the following, for the sake of description, the peculiarities met with in the temperature will be dealt with—

"(I) During the latent period.

"(II) From the discovery of the hematozoon in the blood until death.

"(I) *Temperature during the latent period.*—Unfortunately we have no records dealing with the temperature of animals during the incubative period in naturally contracted cases of surra. We can, however, easily conceive the reason for this want, knowing, as we do, the insidious nature of the onset of the disease and the difficulty there is in deciding when any particular animal was exposed to the contagion. By experimental means, however, we are enabled to obtain an insight into this question, and on studying the charts presented with the following cases it will be found that the thermometric records present considerable variations, in that several different types of temperature curves will be observed during the above-mentioned period.

"In one set of cases the temperature remains low for a few days and then commences to rise, the morning and evening reading being about half a degree Centigrade higher than that of the day preceding, but there being a temporary arrest or remission of 1.5° to 2° C. in the morning.

"In a second series of cases the curve delineated by the temperature readings presents for a varying period a diurnal variation, in some cases showing well-marked intermissions, in others hardly amounting to a remission; and these are followed by a sudden rise of temperature in a few just previous to or, in the majority of cases, subsequent to the appearance of the organism in the blood.

"In a third series the thermometer registers a normal or even subnormal temperature from the time of inoculation until the appearance of the organism in the blood, and this condition has occasionally been observed to persist after the discovery of the hematozoon.

"In a fourth series the temperature commences to rise either gradually or suddenly after inoculation, and attains a maximum varying from 39.2° to 41.2° C., which it maintains for a brief period. It then falls quickly or gradually to a normal or a subnormal minimum, either at the same time or just previous to the first appearance of the hematozoon in the gluteal circulation.

"(II) *The temperature from the discovery of the hematozoon in the blood until death.*—The type of fever appears to vary in different outbreaks of surra, changing according to the locality in which it occurs and the animal affected. In Burmah, Steel described the fever in mules as being of a relapsing type, and there is no doubt that the charts recorded in two cases of the naturally contracted disease bear out his opinion.

"In the cases which have come under our observation animals suffering from the naturally contracted and inoculated disease present at least two varieties of types:

"(1) A continued fever accompanied at tolerably frequent intervals by remissions more or less marked, and after a varying period of days by an intermission of longer or shorter duration. These changes may be repeated several times in the course of the disease. When, however, it arrives at its last stage the thermometer reveals a continued high temperature of a remittent type, or one characterized by morning remissions, and evening exacerbations until death.

"(2) A second and much rarer form is one which may be conveniently divided into three stages. In the first a continuous fever, accompanied by remissions, is present for some days. This is followed by a succession of periods lasting two to five days, each individual period being made up of a gradual or more sudden rise from the normal to 40° or 41° C., or even higher, when it attains a maximum, and after a short time is followed by an abatement of the fever, indicated by a sudden fall in temperature from 2° to 4° C., which may become normal or subnormal, and on such occasions this is succeeded by a period of apyrexia. In the third stage the fever may again take on a continued type, which is not always continuous, but remains high and oscillates freely until death.

"(3) Cases may be rapidly fatal with the temperature remaining subnormal during the whole course of the disease. Vide cases Nos. 32 (35.4° to 38° C.), 30 (35.7° to 38.8° C. just before death), 41 (35° to 37.6° C.), 27 (normal and subnormal, never over 38.7° C.).

"In some instances there may be a sudden rise in temperature just before death, but in the majority of cases there is a fall. In 30 cases under our observation death was followed in 18 by a fall in the temperature varying between 0.5° and 3°C., in 10 by a rise varying between 0.5° and 4° C., and in 2 neither rise nor fall took place."

Burke (1888a, p. 2), in referring to fever, says that its periodicity is perhaps the most characteristic feature, but it is after all an uncertain guide.

The temperature does not often rise above 104° F. (110° F., Steel, 1886a), and may fall as low as 97°. The highest temperature may be followed by a gradual fall and may rise again gradually, until after an interval of 5 or 6 days, the maximum is reached, then there is a fall, or there may be diurnal exacerbations, recalling the temperature chart of malaria in man. Burke (1897, p. 191) remarks that in some cases "the symptomatic course of the disease is very clearly and definitely

marked, the first thing, of course, being the recurring elevation of temperature which is so clearly observed in the human subject." Pease (1897, p. 555), on the other hand, remarks that while *Plasmodium malariæ* causes a distinct intermittent fever, *Trypanosoma* does not, and there is no regularity in the course. In malaria the stadia are short and sharp, lasting but a few hours, while the fever of surra lasts for days, and for extremely irregular periods of time in the course of the same case. Nariman & Vaz (1893, p. 404) speak of the high fever which is periodical, the exacerbations lasting from 5 to 7 days, while the intervals are little shorter. In exceptionally severe cases the exacerbations run to even 10 days, while in mild cases they may not be more than 3 days in duration. Further, it is only during the febrile periods that the other symptoms are marked, but between times the animals are dull and drowsy.

A few days after admission to the hospital the activity of the fever subsides, pulse lowers, and temperature becomes normal.

According to Lingard (1899), the following variations in the temperature of healthy animals were observed at the Imperial Bacteriological Laboratory in India:

Animal.	Centigrade.	Fahrenheit.	Animal.	Centigrade.	Fahrenheit.
Horse	37.2 to 38.3	99 to 101	Cat	37 to 38.6	98.6 to 101.5
Donkey	35.8 to 36.6	96.4 to 97.8	Rabbit	38.8 to 39.8	101.8 to 103.6
Ox	37.7 to 38.3	100 to 101	Guinea pig	38.4 to 39.4	101.1 to 103
Sheep	39.4 to 40	103 to 104.7	Fowl	41 to 42.6	105.8 to 108.7
Goat	38.8 to 40.2	101.8 to 104.3	Pigeon	41 to 43	105.8 to 109.4
Dog	37 to 39.8	98.6 to 103.6			

For horses suffering from surra Griffith Evans (1881, 1882) gives a number of tables of temperature and pulse.

Lingard (1893) gives numerous charts of temperature, pulse, respiration, and hematozoa, from which plates IX to XV are reproduced for this report.

Two further temperature charts are here added, based upon the observations of still a third observer, Pease (1897, pp. 562, 564).

For comparison with these charts of the horse, the following observations on a mule, by Steel (1886a, pp. 171–172), may be noted:

"In the mule there are certain peculiarities of different cases worthy of note: A. Mule No. 13.—Experimentally I obtained the most typical chart from a case induced by the administration of mixed blood (containing spirilloids) and water as a drink to a thickset mule in good condition. The effects were as follows:

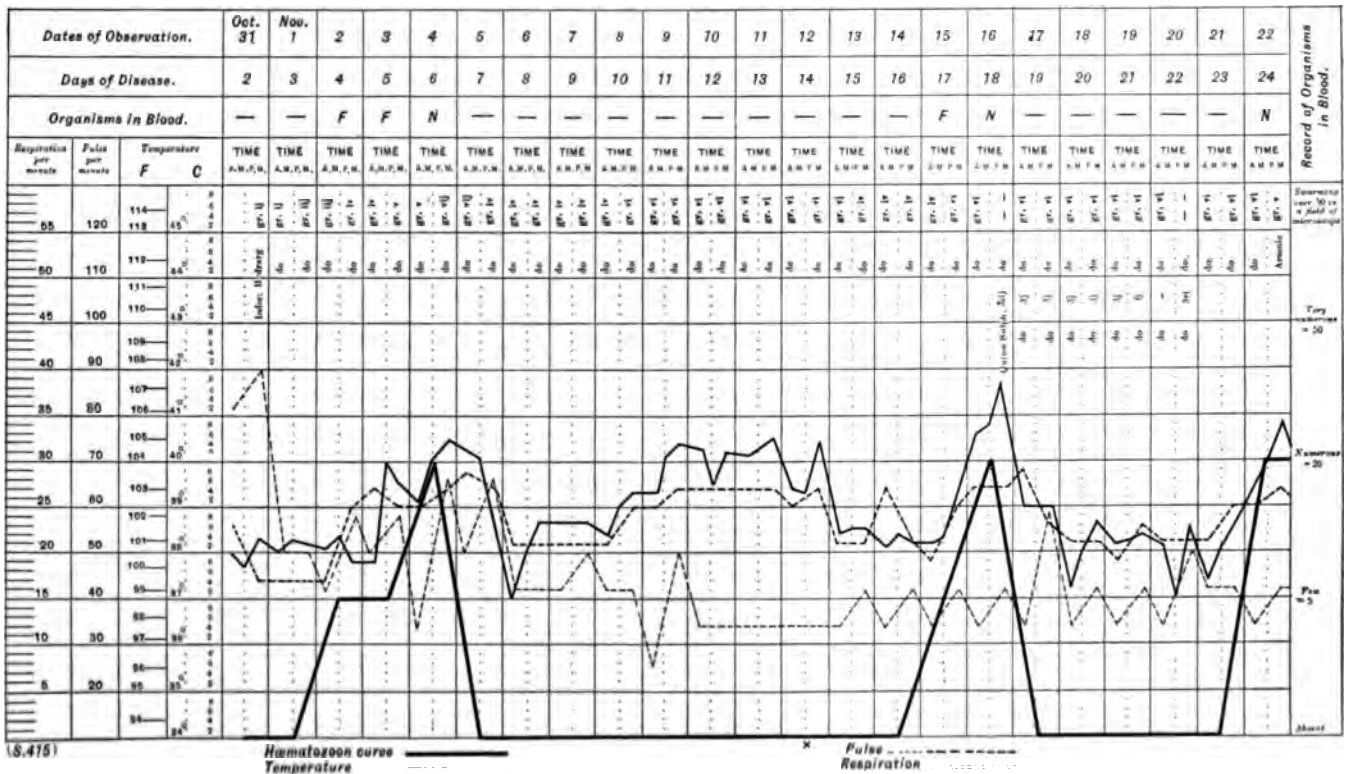
"(*a*) An evanescent rise in temperature of nearly 2° on the evening of experiment.

"(*b*) An *incubation* of 6 days.

"(*c*) On sixth day after inoculation the *invasion* rise began; it was 5° the first day, one-half degree in 2 successive days (eighth and ninth) to 105°, a fall of 2° on tenth day, of over 3° *to the normal* on eleventh day. No appreciable rebound.

Australian Gelding ____ *Age, 7* ____ *Sex, Gelding* ____ *Colour, Brown* ____

Disease, "Surra" naturally contracted. ____ *Date of Attack, 30. 10. 92* *Result, Death* ____ *Date of Result, 17. 2. 93* *Register No.* LXXIII ____



× *Inoculated 3 Guinea Pigs with blood*

(I) *Blood 0·2 c.c. Inoculated on 12th. November 1892. The hæmatozoon appeared on 29th. November 1892. Latent period-17 days. Death 4 Dec. 1892 Days 22*
(II) " 0·25 c.c. " " " " " 24 " " " 12 " 25 Feb. 1893 " 105
(III) " 0·3 c.c. " " " " " 24 " " " 12 " 12 March 1893 " 120

Disease _____ Date of _____ Result _____ Date of Result _____ Age _____ Sex _____ Colour _____

Register No. LXXIII _____

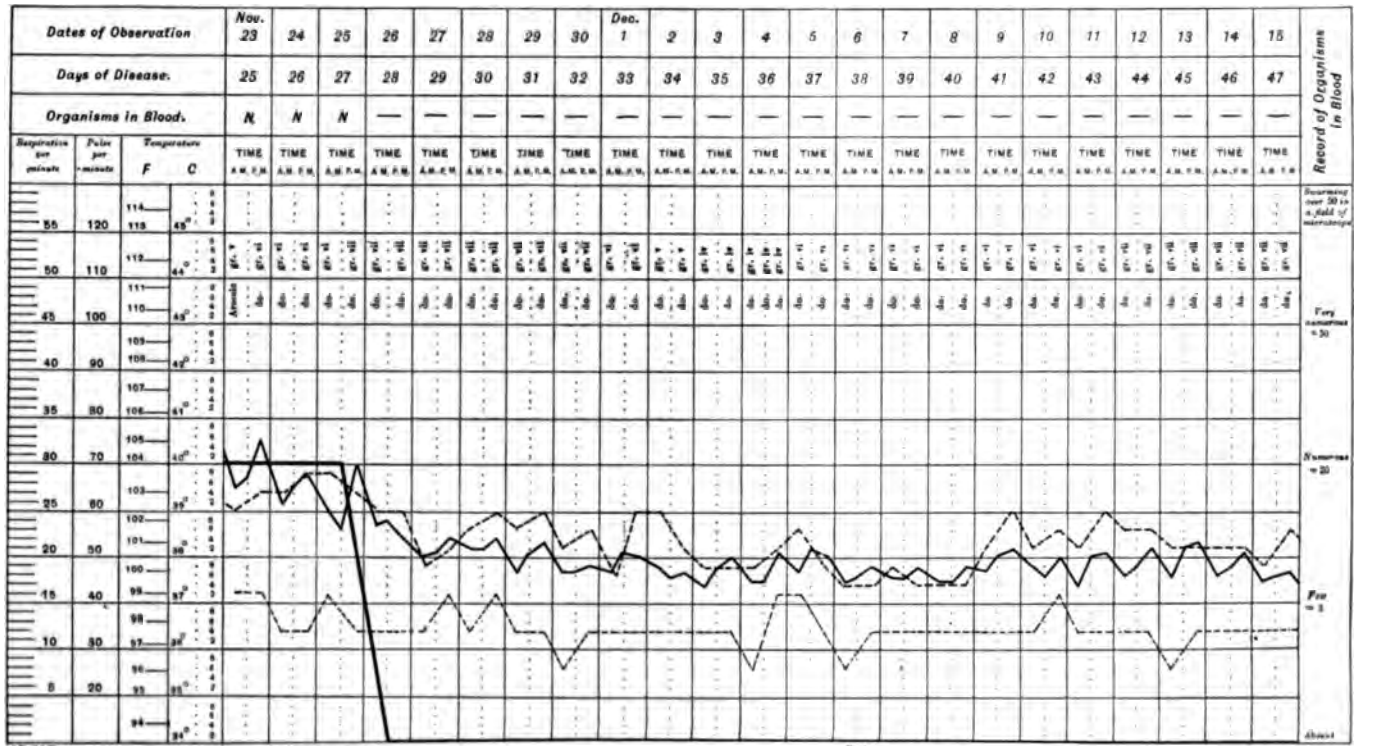


FIG. 90.—TEMPERATURE CHART OF SURRA DISEASE OF HORSE.

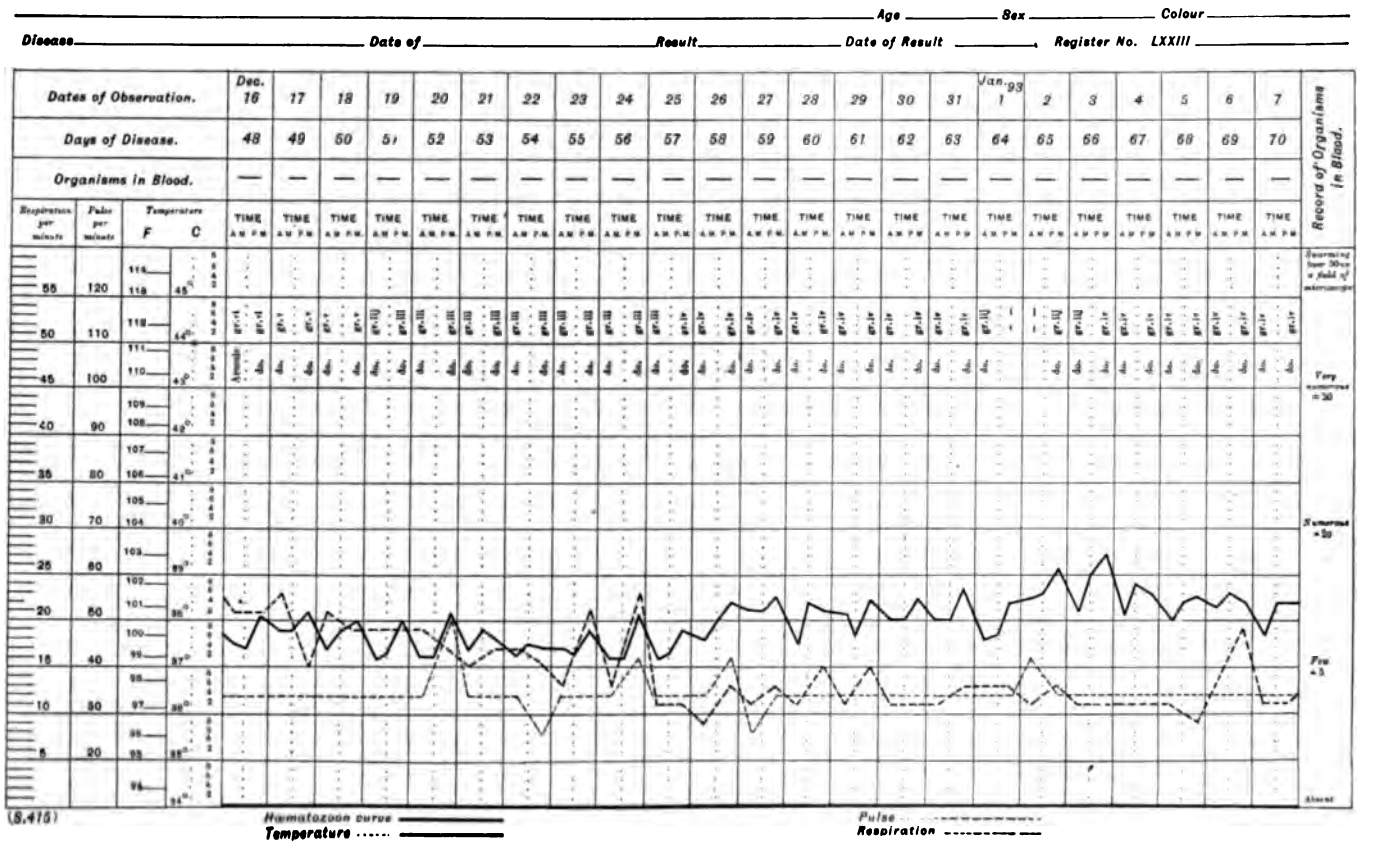
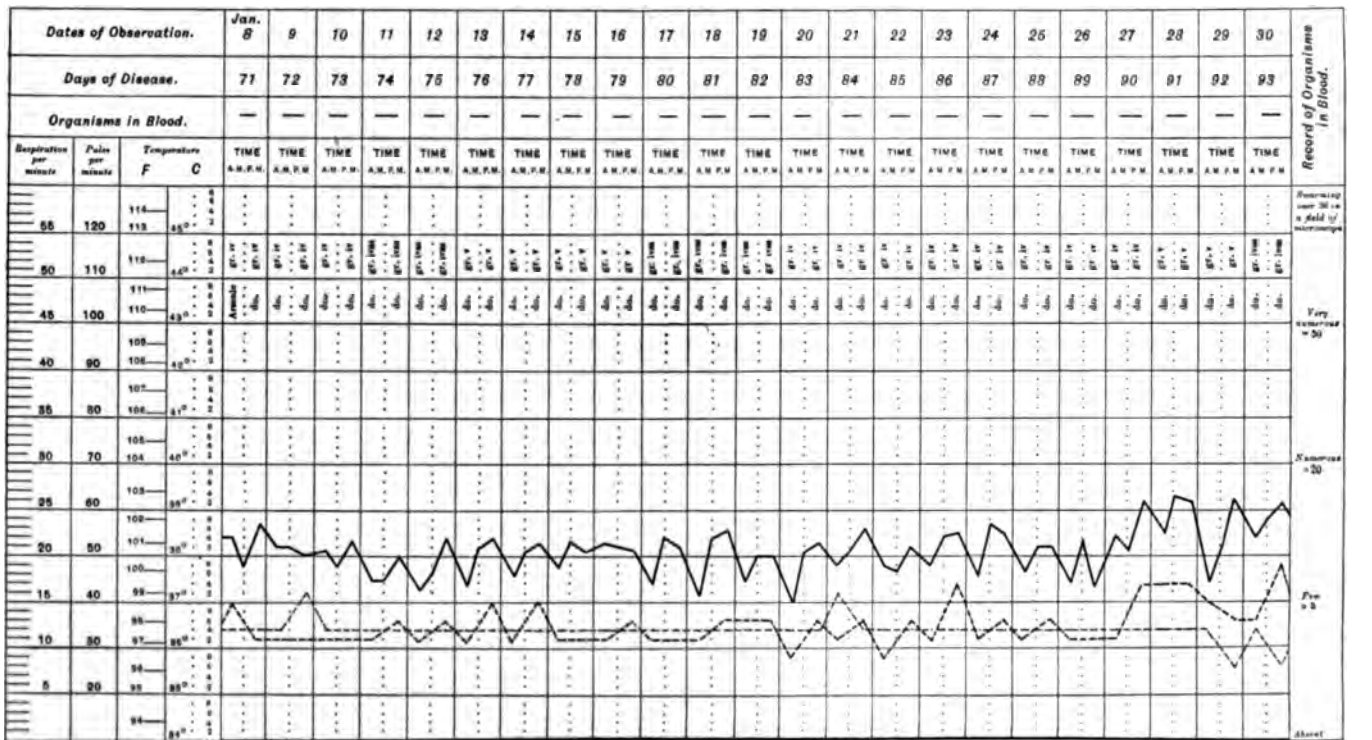


FIG. 91.—TEMPERATURE CHART OF SURRA DISEASE OF HORSE.

PLATE XII.

Age _____ Sex _____ Colour _____

Disease _____ Date of _____ Result _____ Date of Result _____ Register No. LXXIII _____



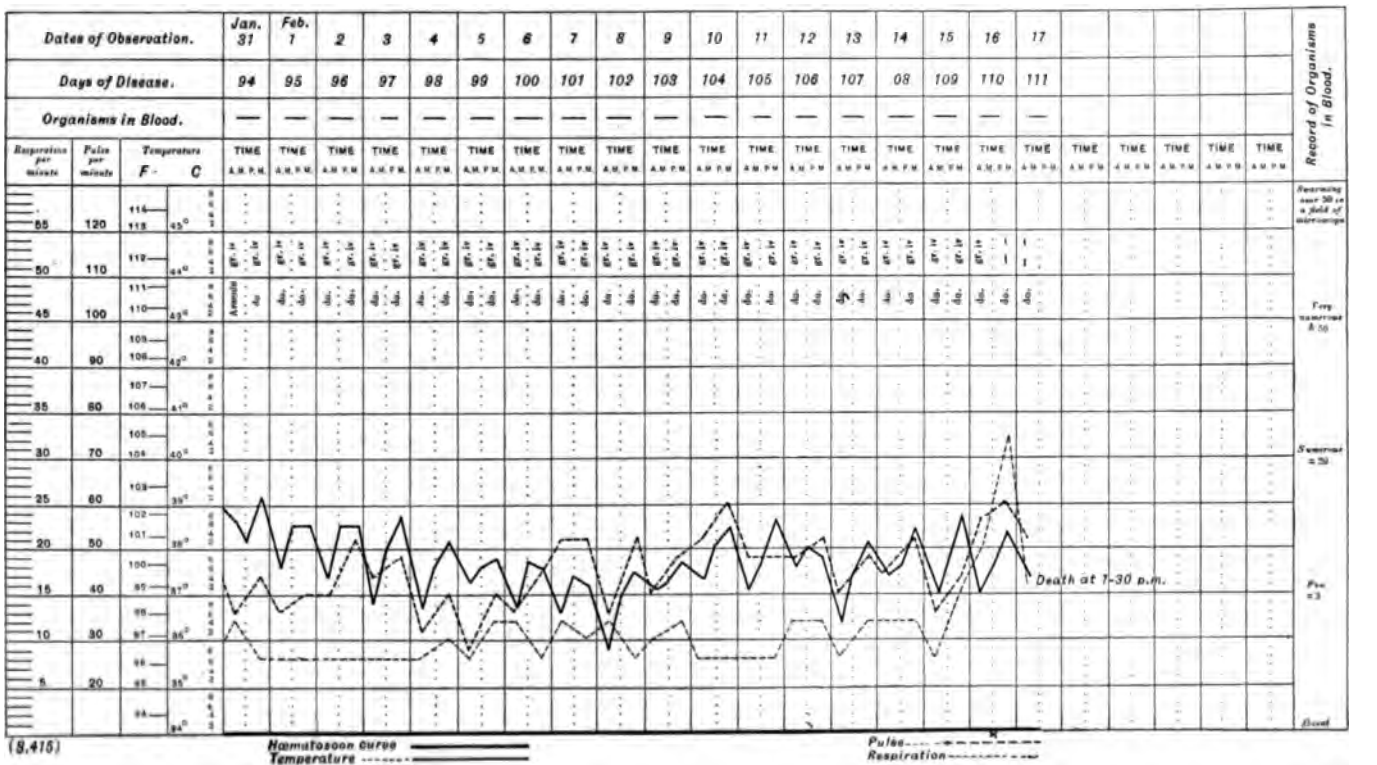
(8.415)

BULLETIN No. 42, B. A. I.

PLATE XIII.

Age _____ Sex _____ Colour _____

Disease _____ Date of _____ Result _____ Date of Result _____ Register No. LXXIII _____



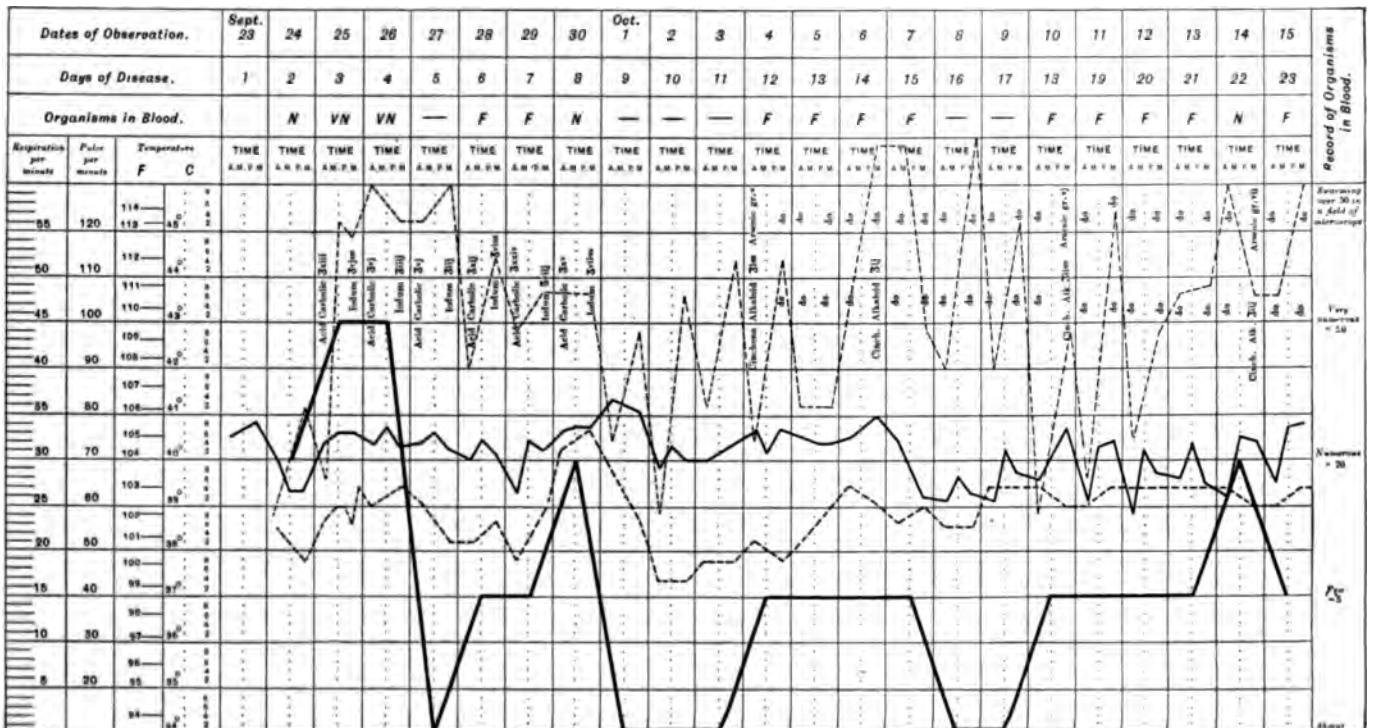
(9,415)

* Inoculated two Guinea Pigs. } 16.2.98. (I) Blood 0·5 c.c. (II) " 0·5 c.c. } Haematozoon absent.

BULLETIN No. 42, B. A. I.

Australian Gelding _____ Age, Aged _____ Sex, Gelding _____ Colour, Grey _____

Disease, "Surra" naturally acquired _____ Date of Attack, 23rd. Sept: 1892 _____ Result, Death _____ Date of Result, _____ Register No. LXX. _____



(S.415)

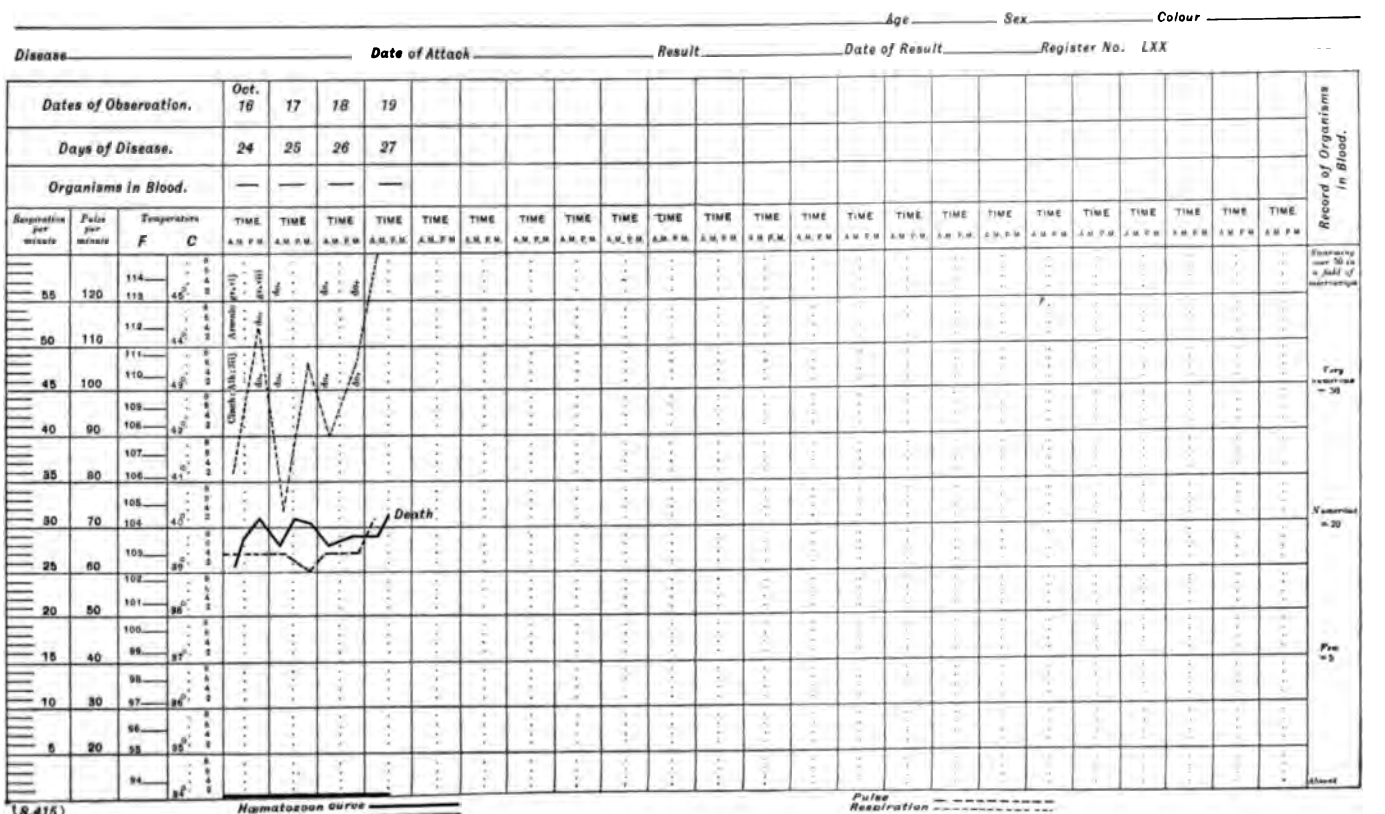


FIG. 95.—TEMPERATURE CHART OF SURRA DISEASE OF HORSE.

fever-free interval of two days (twelfth and thirteenth).
relapse. A rise through 3.5° first day, 1° second day, 2° third day, to a of 106.5° F. A fall through 4° on first day and 2.5° on second day *to the*

nd fever-free interval of 2 days.
d relapse. Rise through 1.5° first day, one-half degree second day, one-half l day, to 102.5°. The reading remains here for fourth day, and then on ls to normal, and on sixth day *below normal.*
ight *rebound* on seventh day, then fall to below normal.
days interval, below normal.
th relapse. Rise through 1° on first and 3° on second day to 103°, a fall of normal on second day.
temperature remains normal 1 day (thirty-fourth after inoculation).
next 9 days are occupied by three acute rises to 103°, 104°, and 104°, re-eparated by two imperfect falls to 100° on third day and to 101° on fifth ne ninth of these days the reading is a little below the normal.
emains so 1 day.
next 6 days occupied by three rises and three falls on alternate days 102/101), (102/99).
temperature remains about normal 2 days, then rises 2 days through 103° lls to 101°, rises to 102°, falls to 99.5°, rises to 105.5°. Then falls in 2 gh 101°) to 99°.
rises to 101° next day, remains so 1 more day, then up to 103°, down to 105°. Then a marked fall to 98.5°.
to 99°; rise to 105°; fall to 100.5°; remains so for 2 days.
to 105°. Then fall for 3 days (102°—99°—to 98°); remains so 1 day.
to 104°; fall to 101°; remains so 1 day.
tion ceases after 83 days from rise. The deductions to be made from this ecord are that after an incubation of 6 days three fever phases can be ach consisting of a rise for 3 days and a fall for 2 days, and these are om each other by intervals of 2 days, during which the temperature normal. Then occur less regular rises, variable in degree, and separated ons variable in degree, but seldom below the normal until toward the last. tendency of the rises to group in threes. The parasites were in this case ound at the periods of most fever. It is hardly practicable to determine of relapses here. The case was 77 days under observation after the first erature."

PATHOLOGY.

rtem examination does not reveal any structural disease Evans, 1881, p. 6). No structural changes were noticed in ys, liver, spleen, heart, lungs, and mucous membrane of the nd intestines. According to Lingard (1893, p. 2), there is e lesion present; (p. 80) the most important element is the of actively moving parasites in the blood.

RIGOR MORTIS.

nortis is normal, and carcasses of animals which have died of sent a dreadfully emaciated appearance, seeming to be com-only skin and bones (George H. Evans, 1899, p. 38).

ANEMIA.

According to Griffith Evans (1881, p. 3), the membranes are blanched. Burke (1888a, p. 3) says there is marked anemia and leucocytosis; (p. 8) extreme pallidity of all the tissues, with perhaps a trifling serous effusion into the abdomen. Later (1891, p. 270; 1897, p. 188) he states that very often there is an acute dropsy, with no other postmortem lesions save extreme anemia and yellow staining of the tissues, due to fatty degeneration.

SEROUS EFFUSIONS.

According to Griffith Evans (1881, p. 6), there is more or less clear serum effused into the peritoneal cavity in all cases, with a slight coating of lymph upon the parietal layer, but there is no sign of any inflammatory action; it is a simple exudation. There is no abnormal effusion in the pleural cavity, but in one case the pericardial sac was greatly distended with fluid. According to George H. Evans (1899, p. 38), there may be an excess of fluid in the abdominal and thoracic cavities, also in the pericardial sac.

PETECHIÆ.

Griffith Evans (1881, pp. 6–7) says that in some cases petechiæ were found on the mucous lining of the intestine similar to those on the vagina and eyelids. According to Steel (1886a, p. 169), the petechiæ seem to appear when the temperature curve begins to fall and the parasites have attained their maximum activity and frequency. The skin occasionally, and the mucous membranes of the mouth and nostrils frequently, are the seat of petechiæ and of very limited degenerations from malnutrition, probably the result of plugging of their small nutrient vessels. We see this plugging on a much larger scale bringing about a defective supply of blood to the limbs, especially the hind ones, for antemortem clots are frequent in this disorder, and may prove the immediate cause of death. The Veterinary Journal, London (1896, p. 181), reports petechiæ on the kidneys. Hayes (1898, p. 481) says there are petechiæ on various internal organs.

JAUNDICE.

According to Griffith Evans (1881, p. 4), the yellowness of the mucous membranes, or jaundice, and the petechiæ remain throughout, though they are variable in intensity.

Lingard (1893, p. 70) says that tingeing of the membranes is a very constant symptom in every case at one period or another. It sometimes is a very early one, and at others does not make its appearance until well on in the disease. It may be evanescent in character, appearing with each paroxysm and gradually fading during the intermission,

until the membranes become perfectly free and pallid, only to return with each exacerbation of the fever. In a second series of cases the color is intense and persists until death, when the tissues of the body will be found to present a deep crude gamboge color. Even when there is little or no tingeing of the mucous membranes at the time of death the gelatinous exudation found so constantly in this disease is always more or less tinged from a light yellow to a deep orange color, and the material surrounding the base of the heart may be specially mentioned as being one of the most certain localities in which to observe it. Nariman & Vaz (1893, p. 404) say there is a well-marked jaundice denoted by the yellowness of the membranes.

FATTY CHANGES.

Burke (1888a, p. 3) states that there is fatty degeneration of the muscles, liver, spleen, kidneys, and other organs. Later (1891, p. 270; 1897, p. 188) he says that there is a large deposit of fat all over the body, especially noticeable under the skin. This gives the tissues a peculiar, jaundiced appearance, which is shown under the microscope to be due to the deposition of fat globules.

ORGANS AND TISSUES.

MUCOUS MEMBRANES.

According to Griffith Evans (1881, pp. 6–7), the mucous membranes everywhere are more or less tinged with yellow, and often the subperitoneal connective tissue is yellow also. According to Hayes (1898, p. 481), the mucous membranes and other tissues are frequently tinged yellow with coloring matter of the bile. (See also "Eyes," p. 64; "Nose," p. 65; "Mouth," p. 67; "Vulva," p. 67; "Stomach," p. 84; "Intestines," p. 85.)

HEART AND BLOOD VESSELS.

Steel (1886a, p. 171) records fatty changes in the heart. He also refers to "green gelatinous extravasations between the muscles of the thighs; greenish white blood clots in the larger blood vessels (a short time after death); antemortem clots, especially in the large blood vessels of the hind limbs."

Lingard (1893, pp. 82–83) gives the following lesions for the heart:

"The cavity of the pericardium generally contains more or less fluid presenting an amber or orange color, and in severe cases it is found deeply tinged with blood. Pericarditis has not been observed.

"*The heart* generally presents some abnormal appearance. The base is frequently the seat of a yellow or orange-colored deposit of gelatinous exudation, which takes the place of the usual fat. This exudation in the great majority of cases is dotted over with small circular ecchymoses, dark red or nearly purple in color, which lie under the visceral pericardium singly or in groups, and sometimes assume the pro-

portions of extravasations. These are also found, but less frequently, invading the external surface of the muscular tissue of the organ, and a common situation for them also is on either side of the coronary vessels.

"The right side of the heart is in most instances dilated, the left side contracted. The muscular tissue is often pale and flabby, and in a state of fatty degeneration.

"The cavities of the right side of the heart, and much less frequently the left, are distended with clots, which present a variety of colors ranging from yellow or orange to green and dark purple. These may be found bathed in dark semifluid blood. These coagula run up the great vessels from the cavities of the organ, and on gentle traction can be detached, and are found to reproduce the branching and peculiarities of the vessel which they occupied. The lining membrane of the right auricle and ventricle, and much less frequently the cavities on the left side, are observed to be stained a dusky red or claret color; but the pathological change, which gauges the gravity of the disease in each individual case, must be looked for and estimated by the number and extent of the subendocardial extravasations. These in cases under treatment, when the hematozoon has been absent for some 10 days, have been found to be entirely absent. In other cases they may be represented by a few petechiæ, and again in more severe attacks extensive extravasations of blood may be present. These subendocardial changes are usually more frequently present in the right ventricle than in the left, and have been noticed in the cavities on the right side of the heart, when they have been entirely absent from the left. They are least frequently found in the left auricle. A common situation for them to occupy is the surface of the musculi papillares, but they may appear on any portion of the muscular wall of the cavity, as well as frequently involving the inner surface of the flaps of the tricuspid and mitral valves. The ventricles occasionally present well-marked signs of fatty degeneration, and, although in the human being the left is the more frequently affected, in these cases the right ventricle has been observed to present the most marked changes, near to the apex of the organ. In cases where the visible mucous membranes have been stained yellow during life, the same coloration of the tissues of the internal surface of the heart has been found well marked. In all the cases the yellow deposit of gelatinous material was present round the base of the organ.

"*Naturally contracted.*—In four of these cases ecchymoses or more extensive extravasations were found on the external surface, lying under the visceral pericardium and well marked in one. Subendocardial extravasations were present on the bicuspid valves in Nos. 56 and 70, and involving the tricuspid valve in No. 70.

"*Inoculated cases.*—In 12 cases ecchymoses were present on the external surface of the heart and internal subendocardial extravasations, as follows:

"In the right auricle, in 2; in the right ventricle, in 12; in the left auricle, in 3; in the left ventricle, in 14.

"The musculi papillares were involved in 4 cases."

Nariman & Vaz (1893, p. 405) also mention gelatinous yellow deposits in the furrows of the heart and often extensive petechiæ under the endocardium. Hayes (1898, p. 481) says there is a yellow or amber jelly-like exudate in the connective tissue of the throat, chest, abdomen, and about the muscles and other tissues, and especially around the base of the heart.

According to George H. Evans (1899, p. 38) the heart has gelatinous accumulations in its furrows instead of fat. In chronic cases the organ is pale, flabby, very often enlarged, and very soft. The cavities are filled with blood or variegated clots, which extend into the great vessels. On several occasions he has observed an atheromatous con-

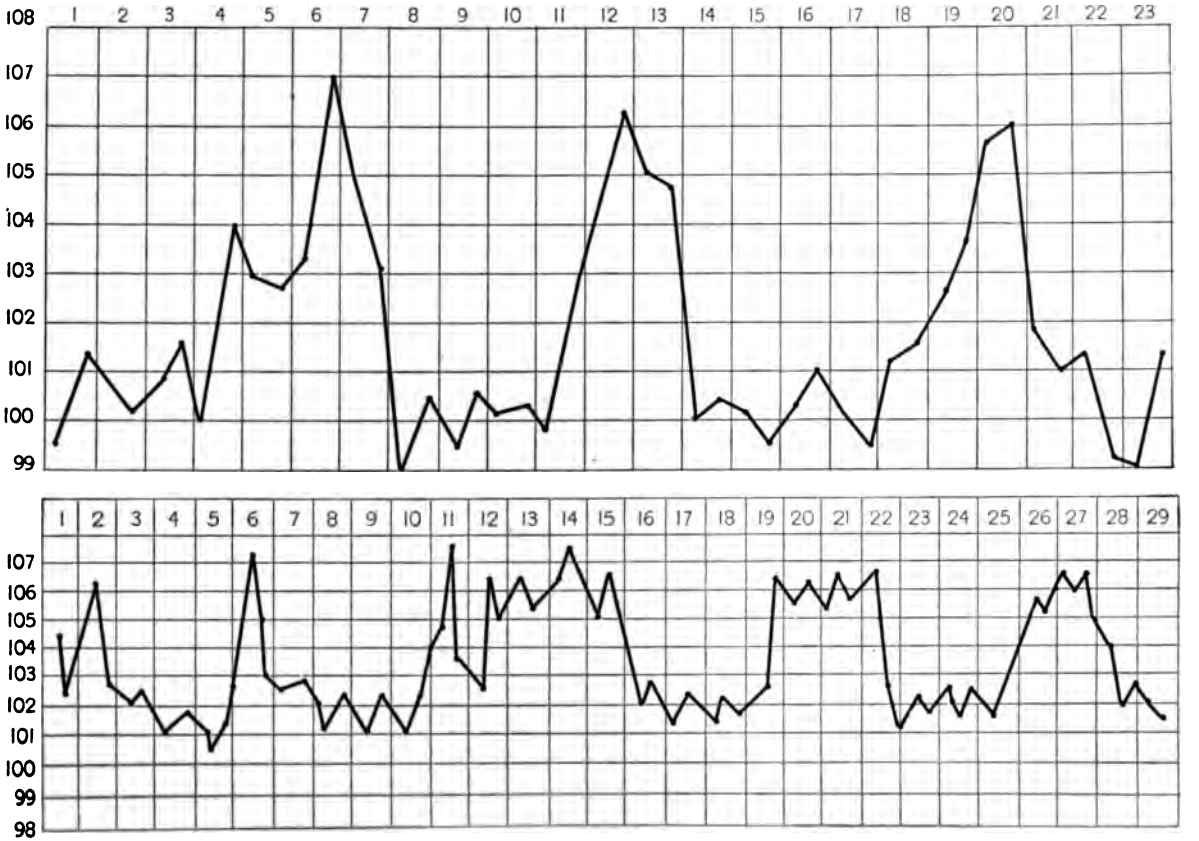


FIG. 96.—SURRA FEVER IN THE HORSE.

dition of the aorta. The heart constantly presents some abnormal condition, the more frequent being more or less extensive subendocardial ecchymoses.

At the base of the heart there is almost invariably a yellow deposit of orange-colored gelatinous material, and the cavities of the heart contain clots of a yellow, green, orange, and purple color, bathed in tarry dark blood. (Vet. J., Lond., 1896, p. 181. See also p. 62, under "Edema.")

Blood, anemia, leucocytosis, and parasites.—According to the more careful observers, there are three things in particular to be noticed in connection with the blood, namely: (1) The presence of the parasites, (2) a destruction of the red-blood corpuscles, and (3) a marked increase of the white corpuscles. Steel (1886a, p. 169) says that frequent dropsies and sluggish vitality of all the tissues indicate the depraved state of the blood. Burke (1888a, p. 9) states that leucocytosis is characteristic of surra, being always present in typical cases.

The Veterinary Journal, London (1896, p. 178), records that at first the blood appears normal, but later a peculiar vibration may be observed, caused by some rapidly moving indefinable organisms among the corpuscles. Later the white corpuscles increase in number, and the red corpuscles, from the attacks made upon them by the hematozoa, become irregular in shape, many of them appearing to be irregular granulated gelatinous masses of a pale color, which form into irregular rouleaux. In the last stages of the disease the plasma occasionally assumes a faint rusty tinge; the parasite attacks the red corpuscle, takes hold of it, tears it, and worries it as a dog would a rat. Griffith Evans (1881, p. 181) records that the hematozoa always fasten to the blood corpuscles by their blunt end, showing a great preference for the concave side of the disk rather than the edge, and breaking up the corpuscle. Burke (1888a, p. 84) and others also describe the attacks on the corpuscles as being a tearing, dragging, or tugging. The white corpuscles are said not to be attacked by the *Trypanosoma*. Lingard (1893, p. 28) estimates as many as 300,000 parasites for 1 c. c. of blood. Nariman & Vaz (1893, p. 405) say that the corpuscles appear to be broken, and many small granules are seen, some of which are freely movable. No parasites were found in the secretions. Nariman believes that between the febrile attacks the hematozoa accumulate in the liver and spleen; for after death, when no parasites are seen in the blood, examinations of scrapings from both liver and spleen show fast-moving round bodies, like the corpuscles. Ranking (1891a, pp. 400–401), who did not admit that surra was due to *Trypanosoma*, and who considered a "bacillus" as the exciting cause, claimed to have noticed "very characteristic changes" in the blood corpuscles. He says:

"*Echinosis.*—At one period they present a peculiar appearance, to which I have given the name of echinosis, for the reason that the individual corpuscles have lost their normal contour and resemble nothing so much as an *Echinus*. * * *

"*Plasmodic.*—At another period, or in some corpuscles at the same period, the interior of the corpuscle is seen to be occupied by a foreign substance presenting ameboid movements and of very various forms, varying from circular throughout stellate and pileate forms to a veritable bacillar form—straight, curved, or spiral. These bodies, I take it, are comparable to, if not identical with, the *Plasmodium malariæ* of Marchiafava and Celli, as they correspond in all particulars, both of morphology and development, with those organisms. In one specimen only have I found the spirillum (*Hæmatomonas*) (*Spirochæt*), hitherto considered to be the effective cause of surra; whereas the organism, whose nature is now described, is invariably present and conforms in all particulars to Koch's postulates. * * *

"*Echinoid stage.*—The blood, then, of a surra animal, when in the stage of 'echinosis,' contains red cells, to the surface of which are adherent, or in the substance of which are embedded, minute circular organisms varying in size from 0.0004 mm. to 0.002 mm. in diameter. * * *

"In some stages these circular organisms, which I shall for the future call 'spores,' are seen free in the plasma in variable quantities exhibiting actively motile properties. They attach themselves to the surface of the red-blood disks, giving rise to the 'echidnoid' corpuscles of early echinosis.

"*Plasmodic stage.*—After a variable time the cells lose their *echinoid* appearance and become *plasmodic;* that is to say, they become occupied by the bodies mentioned above, and compared to the *Plasmodium malariæ*. These plasmodic corpuscles are of irregular contour in most instances, only retaining their disk shape in those cases in which the plasmodium is circular; in other cases assuming more or less the shape of the plasmodium contained in them.

"*Spore stage.*—After a further period the plasmodia break up, undergoing rapid fission into 'spores,' 0.002 mm. in diameter, which escape from the blood cell causing 'late echinosis,' and become free in the plasma. The changes must be observed on a warm stage.

"The red cell, having lost the spores, almost immediately resumes its normal contour, but only for an instant, as it rapidly loses all coloring matter and becomes translucent and all but invisible. These decolorized red cells may again be brought into view by adding a little watery Spiller.

"If now a slide, in which these appearances have been watched, is treated in the usual way for staining spores, it is seen to be full of minute deeply stained spores in a fibrinous reticular stroma, to the meshes of which the spores adhere.

"In addition to the above organisms, the following objects are seen with varying frequency:

"(*a*). Colorless wandering masses of plasma ovoid in shape and beaked or flagellate at either pole, measuring .004 mm. in diameter. These stain with Spiller.

"(*b*). Ordinary leucocytes.

"(*c*). Large irregularly globose leucocytes, mono- or poly-nuclear, in many cases containing the above beaked plasmodia (*a*), and frequently full of motile spores. These are evidently phagocytes.

"(*d*). Mulberry-shaped globose masses of yellow spores. These I have reason to believe are aggregations of spores in phagocyte cells, as they are more common when the animal is evidencing a resisting power against the disease, and may be observed in various stages of development.

"(*e*). Pigment granules solitary or in phagocyte cells.

"(*f*). Ensiform bodies .016 mm. in length, yellow, with white contents separated into two triangular segments, with the bases centrally placed, resembling the bodies figured by Golgi as one stage in the development of Laveran's parasites."

Ranking further says that the blood of ague conforms in pathological appearances with that of surra and an identical bacillus can be obtained.

ORGANS OF RESPIRATION.

Larynx.—The larynx usually presents nothing abnormal. (Lingard, 1893, p. 83.)

Trachea.—The trachea is sometimes the seat of congestion, and contains a quantity of frothy mucus. (Lingard, 1893, p. 83.)

Bronchi.—The bronchi are usually healthy, but occasionally present the signs of bronchitis, or contain purulent material when pneumonia is present. (Lingard, 1893, p. 83.)

Pleuræ.—The pleuræ rarely present signs of inflammation (case No. 8, however, showed signs of recent changes), but sometimes petechiæ are seen lying under the parietal pleura. The pleural cavity seldom contains any fluid, but in three cases several ounces were found in each. (Lingard, 1893, p. 83.) (See also "Serous effusions," p. 78.)

Lungs.—In one case Griffith Evans (1881, pp. 6–7) found the margin of one lobe of a lung hepatized. Steel (1886a, p. 171) records congested lungs. Lingard (1893, pp. 83–84) states that the most common morbid appearances in surra, according to frequency, are emphysema in nearly all ecchymoses lying under the visceral pleuræ, and a localized pneumonia is by no means uncommon. In one case bronchopneumonia was present, but in all the other twelve the lobules were surrounded by a gelatinous exudation, the change resembling pleuropneumonia of cattle. In a large majority of horses examined postmortem the lungs presented calcareous bodies situated rather superficially or in the depths of the tissues, exactly similar to those found in the liver. These are due to some cestode, and the changes are of earlier date, before the contraction or inoculation of surra.

According to the Veterinary Journal, London (1896, p. 181), the lungs are often emphysematous and sometimes the seat of local inflammation, while Hayes (1898, p. 481) says that the lungs often show signs of inflammation.

According to George H. Evans (1899, p. 38) the lungs are healthy as a general rule, but cases in which they are congested are by no means infrequent.

LYMPHATIC GLANDS.

The lymphatic glands throughout the body are more or less swollen and more or less edematous. (Burke, 1891, p. 270; 1897, p. 188.)

According to Lingard (1893, p. 82), the mesenteric glands are not enlarged as a rule, but abnormal appearances were noticed in one case.

ORGANS OF DIGESTION.

Mouth and tongue. (See p. 67.)

Pharynx and esophagus.—The pharynx and esophagus rarely present any abnormal appearance, but if any are present in the latter

organ they are usually small wounds in the epithelium due to the presence of *Gongylonema scutatum*.[a] (Lingard, 1893, p. 69.)

Peritoneum.—Symptoms of old circumscribed inflammation are visible in most cases as perihepatitis and occasionally perisplenitis, the organ being firmly attached to the stomach or to the parieties, but in no single instance has Lingard (1893, p. 82) observed any signs of a general peritonitis.

Mesenteric glands. (See "Lymphatic glands," p. 83.)

Stomach.—According to Steel (1886a, p. 170), gastric ulceration occurs in three-fourths of the cases, especially on the cuticular portion of the stomach; occasionally, also, the villous portion was affected. The ulceration in some cases extended to perforation. It was brought about by a peculiar yellow degeneration of the tissue, and is probably due to embolic plugging of the small blood vessels.

Burke (1888a, p. 5) states that gastric ulcers were frequently observed in the transport mules in the Burma outbreak, and, by way of comparison, he refers to the presence of similar lesions in chlorotic women. Such ulcers do not, however, appear to be present in all outbreaks. Later, Burke (1891, p. 270), in discussing ulcers, says that "the blood itself is rendered unfitted for the purposes of proper nutrition, and degenerative changes of an adipose character, sometimes leading to disintegration of portions of the imperfectly nourished tissue, take place. When organs and parts so weakened by starvation are distended with anemic blood which they can not utilize, sloughs result from gangrene of the imperfectly nourished tissues, as evidenced in the ulcerations of the stomach, etc., noted in this disease. The ulcer itself, once formed, suffers from nutritional defect, owing to the impoverished state of the blood, which prevents the formation of resisting tissue around it, and often leads to perforations."

Gunn states that the villous portion in these cases remained unaffected. In no case was ulceration to be seen, but the cuticular portion of the stomach was much thickened, and on the internal surface were observed numerous papillary eminences, each having a small and somewhat deep central depression.

Lingard (1893, p. 81), in referring to his own investigations, says:

"In this investigation, in the majority of cases, the cuticular portion of the stomach has practically been found free from grave complications.

"In 1 case the cuticular portion of the organ was described as thickened, but inexperience at that early period of the research probably led one to overlook the fact that the coats were merely contracted. A partial yellow coloration of the lining membranes, either only involving the left sac or in others staining both sides of the line of demarcation, was noted in 1 naturally acquired case of the disease and in 5 inoculated cases, and congestion of the cuticular portion was found once.

"The villous portion of the right sac was much more frequently found to be the seat of marked changes.

[a] This is a threadworm which burrows undulating tunnels in the epithelium of the esophagus. It is very common in cattle in the United States.

"Ulcers occurred in 2 cases and were probably due to the effects of parasites; congestion, only in 14—3 in naturally contracted cases, 9 in inoculated animals from horse to horse, and 2 through the goat.

"Petechiæ in 1 naturally acquired and in 3 inoculated. In 1 inoculated case extravasations of blood were present, and small, round, elevated white patches in 1 naturally contracted case. With regard to parasitical tumors, due to the presence of large numbers of the *Spiroptera megastoma*, they were present in 3 naturally acquired cases, whilst in inoculated cases from horse to horse they were observed in 23, and from goat to horse, etc., in 2; and in case No. 33, an extravasation of blood had occurred beneath the mucous and muscular coats."

George H. Evans (1899, pp. 37–38) in referring to surra says that—

"with regard to the postmortem appearances of this disease in Burma, one lesion is rarely if ever absent, namely, some change in the mucous membrane of the stomach, more especially of the cuticular coat, pigmentation, erosion, or ulceration. The positions in which these changes are most constantly met with are along the line of junction of the cuticular with the villous portion, and also at the lesser curvature. If an animal be destroyed during the early stages, discolored muddy yellow patches may be observed; if examined closely, one or all of them may present an eroded appearance. These changes are in most cases no doubt due to thickening and proliferation of the epithelium, which degenerates and breaks down, leaving the yellowish shallow ulcers. These, owing to the progressive degenerative changes, become deeper until, in many cases, perforation occurs. The ulcers may cover an extensive surface. I have seen some 6 or 7 cases in which from half to three-quarters of the cuticular coat was in an ulcerated state; and it was while making postmortems with another officer of the department that we came on two of the cases referred to, and in which no less than three-quarters of the cuticular surface was involved. The animals from which these stomachs were taken were destroyed, as they were suffering from surra. Neither was in bad condition, and both were taking food up to the very last moment. Though the cuticular coat is invariably involved, the lesions undoubtedly do in some cases extend to the villous portion. The anatomical differences, however, naturally, to some extent, alter the appearances of the ulcers, which are often seen with a smoother flat surface, and surrounded by a ring of swollen mucous membrane.

"I am of the opinion that in all cases of death from chronic surra, or in animals that have been destroyed after the disease has been in existence for some time, that ulceration of the stomach, more or less extensive, will be seen postmortem.

"The deep yellow pigmentation is not constant, but in nearly all cases there is a distinct yellowish tinge about the cuticular coat. The villous portion often is in parts, owing to degenerative changes, denuded of its epithelial lining. In some cases a large proportion of the cuticular coat may be pigmented. The color is a bright yellow, which shows up beautifully alongside of the whiteness of the normal epithelium. Parasites (*Spiroptera microstoma*) are constantly found, especially in the stomachs of mules, embedded in the gelatinous mucus of the villous coat, but, as you are well aware, have nothing to do with the disease. Bots are frequently met with, and this year I met with a case where the bots had attached themselves to the mucous membrane of the duodenum; there were quite 100. Spiroptera nests are sometimes seen in the stomach, I think more frequently in mules, but they are rare. Last month I was present at 41 postmortems, but did not observe a single nest. * * * "

Intestines.—In some cases there were petechiæ of the mucous lining of the intestines, similar to what was visible during life in the vagina and on the eyelids. The mucous membranes everywhere were more or less tinged yellow. (Griffith Evans, 1881, p. 7.)

In acute cases there is diffused congestion of the lining membrane of the bowels. In chronic cases there are small localized patches of congestion. (Steel, 1886a, pp. 170–171.)

Steel is quoted by Burke (1888a, p. 8) as authority for the statement that mucous congestions are continuous throughout the anterior two-thirds of the bowel, with presence of several worms. Burke (1897, p. 188) says that the alimentary mucous membrane is in an anemic condition with petechiæ and ulcerated spots [stomach?], the result of disintegration and atrophy.

In referring to the small intestine, Lingard (1893, pp. 81–82) states:

"In a number of cases no pathological change of any kind is observable. On the other hand, it is by no means infrequent to find the mucous membrane between the duodenum and the cecum, more or less injected in patches, and ecchymoses dotted about either singly or in small groups. The solitary glands and Peyer's patches are never found enlarged or ulcerated, but the former present a pale color, whilst in the latter, the slightly pigmented condition of health. In those cases we have examined, the small number of entozoa present in the small intestines have been particularly noticeable, and especially has this been the case in Australians. Of the naturally acquired cases, 2 presented patches of congestion and 1 in those horses inoculated from the goat.

"Ecchymoses were present in 2 naturally acquired, whilst no less than 9 inoculated, animals showed them."

George H. Evans (1899, p. 38) says that he has never observed ulceration of the small intestine, but he has noticed circumscribed local congestions. In a few cases, extensive mucous congestion was noticed. The intestines often contain a quantity of a very yellow fluid. There is nothing remarkable to note about the condition of the large intestine.

Liver. According to Griffith Evans (1881, pp. 5–6), the structure of the liver was not diseased in any case, but in one instance the liver was studded throughout with calcareous degenerations of cestode larvæ. In two cases liver flukes were found with inspissated bile distending some of the bile ducts enormously.

Burke (1888a, p. 9; 1891, p. 271) refers to hepatitis, the early symptoms of which are shown by jaundice of the mucous membranes.

Lingard (1893, p. 82) states that the liver "is nearly always enlarged, especially so when death occurs during a paroxysm. In case No. 15 it weighed 19 pounds 17½ ounces. The anterior or convex surface, as a rule, presents circular patches, white or yellow in color, when the membranes have been yellow during life, and these are due to thickening of the capsule. The surfaces of both lobes in nearly all the cases observed have shown signs of old perihepatitis, and in a large majority of country-bred animals examined, small, round, or irregular masses of a hard, gritty consistency have been present on the surface of the organ, lying under the capsule and more or less invading the tissues; these are of parasitical origin.

"Perihepatitis was present in the organs of all the naturally acquired surra animals examined, and the hard concretions in Nos. 3, 10, 65, 70;

perihepatitis also was found in 16 inoculated horses and concretions in 13."

Nariman & Vaz (1893, p. 405) report that the liver is congested, enlarged, and, in some cases, calcareous. In one case the liver was simply a mass of stone from the aggregation of small calcareous particles, and weighed 49 pounds. The Veterinary Journal, London (1896, p. 177), refers to hepatic disturbances.

Hayes (1898, p. 481) refers to enlargement of the liver and spleen and petechiæ on various organs.

George H. Evans (1899, p. 38) says that the liver is usually healthy, but cases of congestion and softening may be met with. Miliary calcareous deposits are often seen, and in some cases the liver is much enlarged.

Pancreas.—The pancreas is normal. (Lingard, 1893, p. 82.)

Spleen.—Several authors refer to the enlargement of the spleen. Thus Lingard (1893, p. 82) says:

"This organ is always enlarged to a greater or less degree, and, in some instances, has been found to assume abnormal proportions, especially in the case of an animal dying during a paroxysm, when the hematozoon has been swarming in the blood for some days. When, however, the animal succumbs and the organism has been absent for some time, it may be found to be little, if at all, enlarged. The capsule is generally dotted over thickly with irregular-shaped ecchymoses of a brick-red color, which are especially noticeable as they have a bluish-white colored or opalescent background.

"The tissues as a rule, on sections, are firm to the touch and present a dark-red or purplish color.

"This organ was found to be enlarged in 7 out of 9 naturally acquired cases, and in all petechiæ were present showing through the capsule. Of the inoculated cases, in 19 the spleen was enlarged, and in 18 out of 28 the petechiæ were marked."

Nariman & Vaz (1893, p. 405) say that the spleen is generally enlarged and hard, and George H. Evans (1899, p. 38) records that in advanced cases the spleen is generally enlarged. There is, as a rule, an excess of pulp, so that it pits upon pressure. The structure is at times disorganized.

According to Lingard (1895, p. 12), in the case of rats the weight of the spleen increases (from a minimum when the parasite is not present) in proportion to the number of hematozoa infecting the animal, and the maximum size of the spleen is reached toward the end of the rains. (See p. 128.)

URINARY SYSTEM.

Kidneys.—Griffith Evans (1881, p. 5) found the kidneys normal, except in one case, in which they were pale and sodden-like, but Burke (1888a, p. 3) refers to fatty degeneration of the kidney.

Steel (1886a, p. 171) refers to the kidneys as "congested or edematous." Lingard (1893, p. 84), in referring to the kidneys, says:

"*The kidneys*, right—congested.

"*The kidneys*, right—petechiæ. The organs generally present a pale appearance, but

not unfrequently one or both are the seat of numerous petechiæ, in some instances so small as to be only the size of a pin's head, but may be much more extensive. They are scattered over the external cortical surface of the organs, and on section are found to dip into and invade the tissues below. The stellate veins are frequently injected, and occasionally the surface of the organ is the seat of congested patches."

The Veterinary Journal, London (1896, p. 181), records that the kidneys are often pale, flabby, and colored with petechiæ, and according to George H. Evans (1899, p. 38) they are frequently affected; at times anemic and edematous, at others slightly or markedly congested. In some cases he has observed considerable blood extravasation on and in the under parts of these organs.

Bladder.—There is little to note about the bladder. In some cases a patch of extravasation may be observed at the fundus or small petechial spots scattered over the mucous membrane.

MUSCLES.

The muscles of the back, especially in long-continued cases, are found to have undergone considerable atrophy. In the majority of cases they are of a very dark-red color, as if the animal had succumbed to asphyxia. When the case has been complicated by jaundice, all the tissues present a more or less yellow tinge. (Lingard, 1893, p. 80.) (See also "Emaciation," p. 64.)

CONNECTIVE TISSUE AND BONES.

In the majority of cases there is found a varying amount of a gelatinous, light yellow, or greenish colored material, lying in the subcutaneous tissues. This may occasionally be present in very large quantities, especially in the neck, lying on either side of the trachea, in front of the sternum and along the most dependent part of the abdomen, also involving the sheath and the extremities. It is also frequently found between the muscles and running along the sheath of the nerves; and in cases complicated with pneumonia the individual lobules of the lung are divided off or insulated by this jelly-like material. (Lingard, 1893, p. 80.)

The bones and the white tissues of the body generally are tinged yellow in jaundiced cases. (Lingard, 1893, p. 80.)

(See also "Edema," p. 62; "Fatty changes," p. 79; "Jaundice," p. 78.)

NERVOUS SYSTEM.

Steel (1886a, p. 171) reports edema of the brain and spinal cord. Lingard (1893, p. 84) describes the pathological lesions of the nervous system as follows:

"*The cerebral membranes* in the majority of cases present a normal appearance, but in several cases increased injection has been noticed, and in one case the arachnoid presents signs of slight superficial extravasations.

"An access of fluid in the lateral ventricles has been frequently met with. This

fluid is colorless or slightly opalescent, and in cases where the membranes have been yellow during life, the fluid may be tinged.

"The brain and cerebellum are pale, and the convolutions flattened when there is an excess of fluid in the lateral ventricles. The *iter a tertio*, etc., has been observed to be dilated, reminding one of the condition found postmortem in children who have succumbed to ventricular meningitis.

"*Spinal cord.*—In some cases there is an increase in the amount of fluid within the spinal canal, and in others a quantity of gelatinous material in the lower dorsal and lumbar region surrounding the cord, and this may in part account for the priapism in horses which occurs frequently in the course of the disease."

George H. Evans (1899, p. 38) states that he has never discovered extensive lesions in the nervous system. In a few instances the brain substance was undoubtedly soft and the plexus choroides was pale and bloodless. (See also p. 70, under "Action and paralysis.")

COMPLICATIONS OF SURRA.

Pneumonia.—When pneumonia was present, the consolidation was localized or circumscribed. In the majority of cases one lung only was attacked, but the lesions were not confined to any particular position, the apices, anterior inferior angles, bases, and center of the organs being the seat of the change; but in the latter position it was generally superficial, that is, lying directly under and for several inches below the pleura, which was also involved. It was observed in 3 out of 8 cases of the naturally contracted disease, and in 1 out of 2 cases when the disease was transmitted by gastric ingestion. But when transmitted by subcutaneous inoculation of antemortem and postmortem blood, with the former it was seen in 3 out of 19 cases, and with the latter in 6 out of 14 cases. (Lingard, 1893, p. 78.)

Emphysema.—A localized emphysema, usually complicating the apices and the edges of the lungs, was present in nearly every case in horses, but in guinea pigs it was found frequently pervading the entire organ. In several instances, distended lobules lying immediately beneath the pleuræ were found to project in the form of blebs as large as walnuts with very thin and almost transparent walls; while in one case the large bleb was filled with a clear but dark, amber-colored fluid, but not containing red-blood corpuscles.

A collapsed or atalectatic condition, more particularly of the apices, was not an infrequent complication. (Lingard, 1893, p. 78).

Nephritis.—According to Lingard (1899, p. 68), acute desquamative nephritis is a frequent complication of surra.

Pleurisy is an occasional complication. It was noticed in 3 cases; adhesions were present in 1 and with effusion in 2. (Lingard, 1893, p. 78.)

Sudden collapse has been mentioned by Steel as a not infrequent termination in surra cases in mules. In 2 cases Lingard (1893, p. 78) has observed it. In one case the animal fell dead without any premonitory symptoms or warnings of any kind.

Palpitations and vehement action of the heart occur to a greater or less extent toward the termination of every case. The impulse of the heart is so forcible as to move the body of the animal when each beat occurs. (Lingard, 1893, p. 78.)

Pericarditis has not been observed as a complication of surra. (Lingard, 1893, p. 78.)

Hemorrhages.—Lingard (1893, p. 78) observed epistaxis in 2 animals, but the hemorrhage on each occasion was only slight.

Miscarriage.—In small animals, such as rabbits and guinea pigs, pregnant females always miscarry within a short time after the appearance of the organism in the blood. If the female is near the full term of gestation when the organism makes its first appearance in the general circulation, the young may be born alive and thrive. (Lingard, 1893, p. 78.)

Edema of the extremities and undersurface of the abdomen.—In horses edema is of exceedingly common occurrence, and appears frequently as an early symptom. It first involves the fetlocks, more especially of the hind limbs, and gradually extends upward toward the hocks, the most noticeable features being the absence of heat and tenderness on pressure. In horses it is frequently accompanied by swelling and edema of the sheath and scrotum and at a later date spreads forward along the undersurface of the abdomen, finally invading the sternal region. In mares, after the extremities have become involved, small patches of semisolid edema are observed on one side or other of the chest or between the fore legs. As long as an animal is able to assume the recumbent position the exudation does not collect to any great extent, but as soon as the animal is condemned to the upright position for any length of time these accumulations increase, and may attain to considerable proportions. Arsenic when administered in full doses for some days appears to have a beneficial effect. The swelling and edema gradually become less and finally disappear completely. (Lingard, 1893, p. 79.)

Effusion in the joints.—This is sometimes met with, but is not of common occurrence. (Lingard, 1893, p. 79.)

CAUSE OF DEATH.

According to Steel (1886a, p. 169), some cases are acute and prove fatal after supervention of general dropsy, associated with local congestions. Probably the immediate cause of death in such cases is fever, for in his most acute case the animal, about an hour before death, gave the extraordinarily high temperature of 110° F. In chronic cases—that is, in about 96 per cent death is brought about by gastric perforation, antemortem clot in the heart, or simply failure of the heart's action as a result of debility. The animals remain standing to the last, and suddenly fall dead or are recumbent or delirious for some days before the fatal result. Death is usually painless. (Griffith Evans, 1881, p. 3.)

CLINICAL DIAGNOSIS OF SURRA.

While certain symptoms, as already described (anemia, fever, petechiæ, ravenous appetite, extreme emaciation, high mortality, etc.), would naturally give rise to a suspicion of the presence of surra, microscopic examination of fresh blood to find the parasite is the most positive method of diagnosing the disease. In doubtful cases Lingard (1899, p. 60) injected the blood of suspects into guinea pigs and examined the blood of the latter daily. In the ordinary cases of surra, where no treatment has been adopted, the latent period, when guinea pigs are inoculated, is only about one week, but when the fluid for inoculation is taken from an animal that has been subjected to prolonged arsenical treatment the latent period is extended to about three weeks, and this time must elapse before the question can be decided.

"The demonstration of the '*Trypanosoma Evansi*' in equines will distinguish surra from all other febrile diseases. As the periods of intermission in this disease vary in length from one to six days, so, in order positively to exclude the possibility of any cases presenting dubious symptoms being those of surra, it will be necessary carefully to examine microscopically the blood of the suspected animal daily for a period of 10 days. If the result of the blood examination should prove negative during the above-mentioned period, the case may then be safely declared not to be one of surra. It must be borne in mind, however, that a cursory examination of one cover-glass preparation of fresh blood on each occasion will often prove insufficient, for it happens in the course of a case that several days or occasionally a week may pass, during which period only one hematozoon may be discovered in two or even three cover-glass preparations. This most frequently occurs at the commencement or termination of a long paroxysm or in a case of chronic surra." (Lingard, 1893, p. 79.)

For a quick blood examination, it is recommended that a generous-sized blood drop be placed upon a cover slip. This slip is then placed, blood down, upon a slide, and gently pressed so that a blood ring forms around the cover glass. As this blood ring coagulates it seals the preparation. The parasites will be seen swimming with an eel-like motion among the corpuscles. They are about three to four times as long and one-eighth as thick as a white-blood corpuscle.

According to Griffith Evans (1881, p. 185), the parasites may be best observed in coagulated or defibrinated blood.

DIFFERENTIAL DIAGNOSIS.

According to Hayes (1898, p. 483), surra is often confounded with paralysis of the loins. Microscopic examination of the blood will give a positive diagnosis, while this and the chronic course of surra, together with the manner in which the internal temperature varies, distinguish surra from anthrax.

TREATMENT.

Nothing very encouraging can be said at this time on the subject of treatment. It is needless to lay stress upon the fact that a rapid destruction of the parasites is the point of greatest importance.

Salt and quinine are two of the most fatal substances for ordinary protozoa; osmic acid is also very fatal to them. We should be inclined to experiment along the line of hypodermic injections of quinine, salt, and arsenic in the hope of killing the hematozoa.

Griffith Evans (1881, pp. 184–185) has experimented with carbolic acid, but without success.

According to Ranking (1891, p. 403), the disease appears to be controlled by full doses of quinine, supplemented by general measures (chiefly milk, iron, and arsenic) to combat the anemia and weakness consequent on prolonged illness.

Nariman & Vaz (1893, p. 405) say that only two drugs are worthy of mention—inhalation of carbolic acid (1 oz.) in a closed room and the hypodermic injection of 2 grains of corrosive sublimate in a solution of common salt. When the former was used, the parasites disappeared from the blood in about 4 days, while after using the latter no parasites were detected after the second injection. In both cases, however, the animals died after lingering a few days longer. Iodine, iodide of potassium, quinine, and arsenic have failed to make any impression on the disease.

Burke (1897, p. 192) states that "though much has been said and written to the contrary, I hold, that provided prompt measures are adopted, and the disease is treated by quinine, arsenic, iron, and other tonics, by changing the water, and making some variation in the location of the animals, great benefit and even absolute removal of the disease may be secured."

Pease (1897, p. 551) states that quinine in large doses will not control the disease. "One ounce of quinine given daily for 7 days failed to exercise any influence over the surra organism, and had far more effect on patient." The attacks were invariably fatal.

Lingard has discussed treatment more than any other author. He selected the following drugs for experimental treatment:

"*Mercuric chloride* has been employed subcutaneously, and also by direct injection into the circulation, with negative results.

"*Iodine* and *iodide of potassium* by intertracheal injection, and also by subcutaneous inoculation, were followed by negative results.

"*Iodoform*, by subcutaneous injection, and also by direct injection into the jugular, produced no good results.

"*Oleum terebinthinæ*, by subcutaneous injection, and by injection into the jugular, was followed by negative results.

"*Potasii bichromas* directly injected into the circulation, and by gastric ingestion, produced no marked effect upon the infusorian.

"*Mixed cinchona alkaloids* and *arsenic* did not destroy the infusorian.

"*Carbolic acid* and *iodine*, 76 drams of the former, and 34½ drams of the latter in 6 days, produced no apparent effect on the infusorian.

"*Quinine*, in large doses, had no effect on the infusorian.

"*Iodic hydrarg*, a very powerful antiseptic, had no effect.

"*Santonin* had no effect.

"*Potass* had no effect." (Lingard, 1894c, p. 174.)

He reports his best success with arsenic, and he gives the following general directions (1899, pp. 68–69) for its use:

NOTES FOR GUIDANCE IN THE TREATMENT OF SURRA IN EQUINES.

"Only animals in good or in fairly good condition are suitable to undergo treatment for surra. It will be found impracticable to attempt to cure ill-preserved animals, such as Tonga ponies, toward the end of a heavy and hard-worked season.

"2. It is of the utmost importance for the successful treatment of surra that the disease be recognized, and the animal subjected to the drug with the least possible delay.

"3. The weight of the animal should be ascertained frequently when practicable, so that the maximum dose of arsenic to be administered during the treatment may be regulated.

"4. Arsenic should be given in the form of liquor arsenicalis (Fowler's solution):

	Grains.
Arsenious acid (in powder)	87
Carbonate of potassium	87

"Add half a pint of distilled water to these in a flask and heat till dissolved; cool, and add compound tincture of lavender[a] 5 drams, distilled water sufficient to make 1 pint.

"5. In most cases of surra in equines a dose of 5 grains may be commenced with and given twice daily for 48 hours, the quantity being increased by half a grain after every four doses have been administered, until 7 grains are reached. The latter amount should be continued twice daily for 7 days in the case of an animal below 800 pounds in weight; but in Australians of 1,000 pounds in weight and upward the dose may be increased by the addition of half a grain up to 9 or even 10 grains twice daily for the same period. The dose should then be gradually reduced by half a grain or 1 grain, according to the condition of the patient, until a 4-grain dose has been reached. Again, if possible, after a peroid of 2 days, repeat the treatment, increasing and decreasing the dose of arsenic as above described. But the fact must never be lost sight of, that, if arsenic be administered to an animal for a prolonged period, symptoms of gastric irritation will supervene sooner or later. It has been found that by giving *kaunji*[b] to the animal, morning and evening, directly after the medicine, the above-mentioned symptoms have not made their appearance; consequently, it would be advisable to give *kaunji* to the animals from the commencement of the arsenical treatment.

"6. Daily microscopic observations of the blood should be made, and the number of organisms recorded on a chart for ready reference, together with the temperature, pulse, and respirations of the patient, which should be taken three times daily, namely, 8 a. m., 1 p. m., and 5 p. m.

"7. Most animals will take the drug in one or two pints of water from a bucket without any trouble. If this be found occasionally impracticable, the arsenic can be mixed with the corn and bran in the form of liquor arsenicalis; but in obstinate cases the medicine will have to be administered to the animal in the form of a bolus or in a draught.

"8. Acute desquamative nephritis is a common complication of surra, but it must not contraindicate the administration of arsenic, although the maximum doses can not be maintained; otherwise the animal will have a relapse and ultimately succumb to the disease.

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[a] The compound tincture of lavender may be omitted, but the animals under treatment take the medicine more readily when it is present.

[b] Linseed, rice—ā ā one-half pound. Add water a sufficiency. Boil for three-fourths hour, and give when cool.

"9. Animals suffering from surra, as a general rule, have voracious appetites. It has been found by practical experience that the following amounts of hay, corn, etc., are necessary for an Australian horse weighing 1,000 pounds and over; for on this the animal keeps in fair condition and during convalescence puts on flesh rapidly:

Hay, 15 to 20 pounds
Lucerne (fresh), 10 pounds
Barley,* 8 to 14 pounds
or
Gram, 6 to 10 pounds
Bran, 1½ to 3 pounds
Salt, 1½ ounces
} Daily.

"10. When once the organism of surra has vanished for some days from the circulation of the animal under treatment, gentle exercise, commencing with 500 yards and gradually increasing to 1 mile, morning and evening, may be allowed. But if the temperature becomes elevated, all exercise must be stopped until the former again registers within normal limits.

"11. The exudation of semisolid material (edema) into the subcutaneous tissues, notably that of the lower extremities, sheath, and undersurface of the abdomen, generally becomes absorbed after a time under the influence of arsenic and exercise, but this may be accelerated by daily massage of the body and limbs.

"12. Surra horses, under treatment with arsenic for long periods, and which eventually die, at their autopsies frequently present some atrophy of the spleen. Consequently, subcutaneous injections of infusion of spleens have been made in order to ascertain whether the material injected would perform the function of the atrophied organ. Encouraging results have been obtained.

"13. Certain of the horse-surra cases under treatment somewhat suddenly developed symptoms of chronic arsenical poisoning. These, which include partial loss of power over the hind quarters, crossing of the hind limbs when walking, and general unsteadiness and nervous tremors, usually proved fatal within 48 hours, although the further administration of the drug was immediately discontinued on their recognition. In some of the later cases under our treatment these fatal symptoms have been successfully combated by the subcutaneous injection of infusions of spleen and testicle (sheep).

"14. The question with regard to the administration of arsenic to animals at the commencement of the rains as a preventive in districts where surra is epizootic is one worthy of trial. A dose of 5 grains of arsenic in the form of liquor arsenicalis (10 drams) given once a day in the drinking water to each animal could not fail to produce a beneficial effect, and could with safety be continued for a month at a time. The dose of arsenic should then be gradually reduced every 3 days by half a grain at a time until it is discontinued altogether. An interval of 7 days should then be allowed to elapse and again the same process persevered in, with intervals, until the termination of the rains or end of October."

[The following important circular regarding treatment has recently been issued in the Philippines:

CIRCULAR, No. 4.

HEADQUARTERS DIVISION OF THE PHILIPPINES,
Manila, P. I., January 11, 1902.

The board ordered to inquire into and investigate a disease of animals called "surra" have found that Fowler's solution of arsenic given intravenously destroys parasites in nearly every case, and animals so treated are doing well; but such treatment is as yet not conclusive as to cure. Such treatment may be tried at all points where animals are infected.

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*Boil half the daily quantity given to the animal morning and evening with half the amount of salt for 1½ hours, then mix with the bran and give when nearly cold.

The board also reports that common house flies taken on sick animals have been found full of parasites, and it is therefore ordered:

That all abrasions or wounds be kept covered to prevent possibility of infection from this source.

By command of Major-General Chaffee:

W. P. HALL,
Assistant Adjutant-General.

Undoubtedly the intravenous injection of arsenic will be found much more satisfactory than Lingard's method. Regarding the flies, a confusion has taken place. The fly referred to is the stable fly (*Stomoxys calcitrans*), not the common house fly (*Musca domestica*). The latter species does not bite.]

PREVENTION OF SURRA.

A number of authors have urged the earliest possible removal of animals to camps or to healthier grounds as soon as surra breaks out. Several authors propose that greater care be exercised in regard to the food, water, and care of the animals. In discussing preventive measures, Pease (1897, pp. 561–562) makes the following interesting remarks:

"The methods of prevention suggested by Burke have been suggested years ago for other diseases, and have been consequently carried out as far as is practicable, and, I regret to say, are found to prove ineffective in regard to surra. If the animals remain in a surra zone, as in many cases they must do, the most minute precautions appear to be valueless. In this regard the following case may be quoted. The Naini Tal horse dâk line, running from Kathgodám to Naini Tal, have for years suffered great losses from the disease. In order to eliminate as far as possible every imaginable means of introducing the disease, the following precautions were taken:

"1. All the water given to the horses to drink was thoroughly boiled.

"2. No animal was allowed to drink water or graze anywhere outside. Muzzles were worn whilst they were at work.

"3. The hay upon which they were fed was especially collected, under European supervision, from the high mountains, at an elevation of from 5,000 to 6,000 feet, and carefully stacked.

"4. No green fodder of any kind was allowed.

"5. All grain was carefully hand-picked and screened before use.

"6. Thorough cleanliness and disinfection of the stables were maintained, and the animals were well protected from the weather.

"The management of these animals was perfect, the superintendent being a European of great experience.

"Result of the precautions: Every single horse belonging to the company perished from surra in the season (1896).

"In the same way the disease annually occurs in the Bombay tramway stables, a perfectly managed concern.

"This points to the conclusion that there is some other method of introduction in these cases, possibly flies, which we can not guard against."

Lingard's (1899, pp. 69–70) suggestions as to prevention are summarized as follows:

PREVENTION AND LEGISLATION.

"As it is recognized that surra may be propagated in animals by means of drinking water, fodder, rat excrement mixed with corn, and the bite of certain kinds of

flies, the following rules for guidance were drawn up some years ago (1894), and owners of dâk animals in certain surra localities were informed of the best means of trying to protect their animals from acquiring the contagium. The following are the most important:

"1. All water for drinking purposes should be boiled, when possible, from [during the months of] June to October, inclusive, before being given to the animals at stations in districts infected with surra.

"2. Hay should be made in cold weather (October to January), and stacked for the use of animals during the rains. The hay is to be obtained from uplands, or from land not subjected to inundation, or, better still, from land entirely beyond the affected area. Green food should, during the rainy season, be prohibited, unless it is brought from without the surra area.

"3. All gram and corn to be screened and cleaned before being given as food.

"4. The use of the bel (creeper) leaves as food to be discontinued during the months of June to September, inclusive."

"Suggestions applicable to animals working on certain dâk lines where surra appears annually in the rains:

"1. Dâk animals, when returning to their own stage, should not be allowed to graze or drink water along the road, especially during the months of May to October, inclusive.

"2. A light preventive muzzle might be introduced.

"3. All diseased animals should at once be isolated at a considerable distance from healthy ones, and subsequently destroyed if not subjected to treatment.

"4. All carcasses should be burned, together with the dung and stable litter, where wood is available for the purpose; otherwise, deep holes should be dug and the bodies buried at a depth of 6 feet.

"5. Stables should be erected on high ground, and not, as so frequently happens, in a hollow bordering on the bed of a river.

"It is well known that surra, when untreated, is an absolutely fatal malady, the disease taking an unusually rapid course in the case of overworked animals. When once the disease is diagnosed the animal is useless. Isolation and subsequent destruction, therefore, would entail no hardship to owners; and power to enable officers to enforce it, and the burning of all diseased carcasses, would be a great step toward the limitation of outbreaks.

"The question of the introduction of an act to limit the spread of surra, as in the case of glanders, is an important one. It would be useless, however, to bring one class of animals (tonga ponies) under an act unless the other (ekka ponies) were likewise included; for at present the former only are under compulsory registration, although the latter are quite as numerous.

"No government official can interfere with animals the subjects of surra; consequently, only advice can be given to the owners as to the best means of prevention against the spread of the disease."

Some of these suggestions appear to be rather difficult of execution and others appear to us unnecessary.

Considering the present status of the subject, we would suggest the following points for consideration in the Philippines:

(1) As horses and mules are more severely affected than donkeys and cattle, it would be well to depend upon the former as little as possible. Transportation trains using donkeys and cattle will be less liable to destruction than those using horses and mules.

(2) Avoid the introduction of Australian horses.

(3) Avoid light-colored animals as much as possible; the darker the animal the safer he appears to be from the attacks of flies.

(4) Isolate infected animals and protect them from flies, especially if they have wounds or sores of any kind. A coating of tar and linseed oil or any similar substance over a cut will protect it from flies.

(5) Protect stock from flies in wet weather by use of smudges and by smearing. Among the various substances used for this purpose may be mentioned the following:

PREVENTIVES.

"Smudges had thus far proved the best method of protecting animals in the field against buffalo gnats. Thoughtful planters are in the habit of collecting and storing during the year all kinds of material that will produce a dense and stifling smoke; such materials are old leather, cast-off clothing, dried dung, etc. As soon as large swarms of gnats appear, and the stock is threatened by them, fires are started in different parts of the plantation, and are kept burning as long as the danger lasts. Anything that will produce smoke is thrown upon the smoldering logs, and the most offensive is considered the most useful. If the time for plowing has arrived, smudges are located in the fields in such a manner that the smoke is drifted by the wind over the teams at work. Such smoke-producing fires are also kept burning in the cities, and they are found in front of every livery and street-car stable, as well as of such stores as employ draft horses or mules. If these animals have to be upon the roads, they may usually be somewhat protected by tin pails in which some smudge is kept, and which are suspended from their necks and from the wagons.

"Animals may also be protected with a layer of mud or a coat of sirup. It has been found that animals which have shed their rough winter coat of hair and have become smooth are not as much troubled as others still covered with long hairs. The gnats find it much more difficult to obtain a foothold upon a smooth skin, and the clipping of the hair in early spring is therefore advisable.

"Buffalo gnats have a great aversion to entering dark places, and stables thoroughly darkened are safe places for stock of all kinds in a gnat season. The odor of ammonia prevailing in such stables may also to some extent prevent the insects from entering. Planters with a small acreage, therefore, prefer to keep their horses and mules in the stable instead of working them in the field. For the same reason the owners of livery stables will not allow their animals to be taken outside the city limits if gnats are numerous enough to be dangerous.

"But the great majority of planters can not wait for the disappearance of the pest, and have to resort to other defensive means. Various external applications have been used to this effect. Decoctions of alder leaves, tobacco, pennyroyal, and other herbs have been tried with a view of preventing gnats from biting mules while at work; but all of them have proven ineffective. At a time when small swarms of turkey gnats were tormenting mules plowing in the field one side of the animal was moistened by Mr. Lugger with various insecticides, while the other side was not protected at all. By following the animal and watching the gnats it was soon observed that any offensive smelling substance would drive the gnats from the protected side to the unprotected one. Kerosene emulsion, pyrethrum powder suspended in water, diluted carbon bisulphide, and dissolved tobacco soap were all used in turn, and all seemed to produce the same effect. Several times the whole animal was carefully sponged with the one or the other of the above substances. For a time the gnats would not settle upon the animal; but in the course of two hours the beneficial effect of these insecticides was gone and the insects were no longer kept away.

"Experience shows that the best preventive is grease of various kinds. The following kinds are the most important: Cotton-seed oil alone, or mixed with tar, fish oil, gnat oil; a combination of stinking oils alone, or mixed with tar or kerosene oil, crude coal oil, kerosene oil, kerosene oil mixed with axle grease, and others. To be effective, the grease must be used at least twice during the day, because as soon as its offensive odor disappears it becomes inoperative. All such applications are of no advantage, however, on stock running at large. Gnat oil is very extensively used, but it is, like the rest of the remedies, very apt to remove the hair. In fact, all these different kinds of oil and grease are more or less injurious to the animals, because a continued coating with them weakens the system.

"The employees of the Hudson Bay Company protect themselves and their stock against the bites of the "black fly" by the use of oil of tar, and, as long experience has shown, it to be a simple and easily applied wash, we strongly recommend its use. A quantity of coal tar is placed in the bottom of a large shallow receptacle of some sort, and a small quantity of oil of tar, or oil of turpentine, or any similar material, is stirred in. The receptacle is then filled with water, which is left standing for several days until well impregnated with the odor. The animals to be protected are then washed with this water as often as seems to be necessary.

"As long as stock in the infested region is suffered to run at large, and is neither provided with shelter nor food during the winter months, it will suffer severely from the gnats. Animals well cared for can stand the attacks of the gnats far better, and do not perish as readily. Illtreated and unhealthy mules and those bruised and cut are the first to die, and the prevailing opinion of intelligent planters is to the effect that well-cared-for mules, if greased twice a day when working in the field, seldom die even when attacked." (Osborn, 1896, pp. 36–37.)

Stordy (1899, p. 14) gives a figure of a pony in pajamas as a protection against tsetse fly.

(6) So far as possible, avoid camping in moist and marshy localities.

(7) So far as possible, prevent flies from breeding. Since many flies—and among these the biting stable fly (see p. 109)—breed in manure, the fly pest may be greatly lessened by a proper handling of the dung. The outside manure pile should be abolished, and every stable should have attached to it a well-screened dark closet in which the droppings can be collected. A small shovelful of chloride of lime scattered over the freshly collected manure every morning, together with keeping the manure in the dark and screened, will do much toward preventing the increase of flies.

HORSEFLIES (FAMILY TABANIDÆ).

In order to place interested persons in immediate possession of the more important points in regard to horseflies of the family Tabanidæ, the following account of these insects is quoted from Osborn (1896, pp. 58–71):

"The members of this family are large, some of them being among the largest of the order Diptera, and the females are provided with powerful mouth parts by means of which they inflict very painful bites upon cattle, horses, and other animals. Man does not escape, and as they are able to penetrate even thin clothing worn in summer, they sometimes become a source of annoyance to workmen in fields.

"The bodies are never very hairy, the head is large and composed almost entirely

of the eyes, which during life are of brilliant colors and varied reflections. The antennæ are prominent and the third joint is composed of from three to eight minute rings, a character which, with the large eyes, distinguishes them at once from nearly all other large flies. The strong piercing mouth parts of the female are composed of six lancet-like organs, while in the male there are but four and these are not adapted to piercing the skin of animals. The males, and also the females, if not finding other food, feed upon the nectar of blossoms or the juices of plants, exuding sap from trees, etc.

"The flight of these flies is very strong and rapid and is attended with a buzzing, tormenting noise. The males may often be seen with the wings vibrating so rapidly that they become invisible, resting motionless in one place and then darting rapidly and resting suddenly again, generally turning the head in some other direction each time they dart. St. Fargeau has ascertained that this maneuvering is performed in order to intercept and seize the females. The power of vision is apparently in proportion to the size of the eyes. Dr. Williston says 'that they can see for a long distance seems certain. On the uninhabited plains east of the Rocky Mountains the writer has frequently seen them coming from a long distance, attracted by the sight of the horse on which he rode.'

"Such of the larvæ as are known are either aquatic or live in moist earth and are carnivorous, hence they may in some degree compensate for the bloodthirsty habits of the adult females. But notwithstanding the abundance of the insects, very little has been done toward determining the early stages of the species. More than a century ago De Geer described the larva of the common European species, *Tabanus borinus*, and up to 1864 this was the only larva of the kind known. In that year Mr. Walsh described a tabanid larva (Proc. Bost. Soc. Nat. Hist., Vol. IX, pp. 302–306), but without obtaining the adult form. In 1869 Professor Riley bred the same kind of larva to the adult form and described the various stages (Second Rep. Mo. State Entom., pp. 128–132), the insect proving to be *Tabanus atratus* Fab., which is described further on.

"Dr. Williston says: 'The spindle-shaped brown or black eggs are found in spherical or flat groups, stuck together, and attached to the leaves or stems of grass and other plants; those of the aquatic larvæ are fastened to rushes. The larvæ are carnivorous; many live in the earth, others in water. They are predaceous, often upon snails and injurious insects, thus in a measure repaying the agriculturist for the molestation they cause him. The young larvæ are known to penetrate beetles or other larvæ and remain within them till they have completely consumed them, and their enlarged bodies have filled out the skins. Thus the larvæ of *Hæmatopota* have been observed feeding upon *Helops* and those of *Tabanus* upon Noctuæ.' (Stand. Nat. Hist., Vol. II, p. 417.)

"Quite recently Mr. C. A. Hart has made a notable contribution to our knowledge of this subject,* which will be drawn from in discussing the early stages of particular species.

"Authors generally agree that the after effects of the bites of these insects are less injurious than those of mosquitoes or buffalo gnats. The painfulness of the bite and the terror inspired by their presence is, however, a source of great torment to animals that are almost helpless in protecting themselves against them. The puncture they make is large, and after the proboscis is withdrawn there is not unfrequently an exudation of blood from the wound. This would tend to remove any poisonous injection, but since there is rarely any swelling or inflammation produced by these bites, it would appear that no poison is conveyed upon their piercing organs. Dr. Packard speaks of cattle and horses being 'occasionally killed by their repeated harassing bites,' and while this seems to be rather strong language, and we will refer to it again in considering *Tabanus lineola*, there is no question that the

*Article VI, Vol. IV, Bull. Ill. State Lab. Nat. Hist.

effects are serious enough, so that it is desirable to protect animals as far as possible from their bites.

"With horses in use the common practice of protecting with nets is the most effective method we know of, but for animals in pasture it would be particularly desirable to find some substance which could be rubbed over the hair, and, retaining its properties for a reasonable length of time, have sufficient repelling power to keep the flies away.

"The larvæ are not open to successful attack, and even if they were, the fact that most of them are probably beneficial should deter us from using destructive measures against them.

"They are widely distributed, and species occur in all parts of the world, torturing alike the elephant and lion of the tropics and the peaceful reindeer of the arctic region. It is during the hottest summer months that they are the most abundant, and they frequent both our timbered and prairie regions.

"The species are quite numerous, over 1,300 being known, of which about 150 are credited to North America. Manifestly it would be impossible in a work like this to even mention more than a few species, and, since so little is known of the early stages, there is no necessity for treating each species in detail. We will therefore in considering the species simply refer to the more common ones, the habits of which have been observed, and more particularly those occurring in this country.

"Osten Sacken's admirable 'Prodrome of a Monograph of the Tabanidæ of the United States' in Memoirs of the Boston Society of Natural History (Vol. II, Part IV, Nos. 1 and 4) will enable anyone to make a thorough study of our native species.

The Black Gad Fly, or Breeze Fly.

(*Tabanus atratus* Fab.)

"Probably this is the largest species in the family, and it is certainly one of the most conspicuous, being quite common and of such a decided black color as to attract attention either on the wing or when perched on the back of some poor animal that tries in vain to drive it off. Fabricius described it in 1794 (Ent. Syst., Vol. IV, p. 366). Walsh described its larva in 1864 (Proc. Bost. Soc. Nat. Hist., Vol. IX, pp. 302-306), and in Riley's Second Missouri Report (p. 128) its life history is given except the egg and early larval stages. Its bite is one of the most severe of the tribe, but fortunately the species does not occur in such great numbers as the greenhead fly. Its attacks seem more commonly directed against cattle than horses, and it is most noticeable in sunny pastures, though occasionally seen perched on trees or the side of some building. The eggs are doubtless deposited in the vicinity of water, in moist places, but the exact details of oviposition are unknown.

Fig. 97.—*Tabanus atratus*: *a*, larva; *b*, pupa; *c*, adult (after Riley).

"'The larva (fig. 97, *a*) is a large, twelve-jointed, cylindrical affair, tapering at each end, of a transparent, highly polished, glassy, yellowish, or greenish appearance, shaded with bluish green and furnished above and below, as in the figure, with large, roundish, sponge-like tubercles which are retracted or exserted at the will of the insect. Though the external integument is so transparent that the internal structure

is readily visible, yet this integument is firm and the larva most vigorous and active, burrowing with great strength either backward or forward in the earth and between one's fingers when it is being held. Placed in water it will swim vigorously by suddenly curling round and lashing out its tail, but it is apparently not as much at home in this element as in the moist earth, for it is restless and remains near the surface with the tip of its tail elevated in the air. When the water is foul it moves about actively near the surface, but when it is fresh it remains more quietly at the bottom. The specimen which I succeeded in breeding was sent to me by Mr. Adolph Engelmann, of Shiloh, St. Clair County, Ill. It was found by Mr. William Cooper, of the same county, about 10 feet from a small but permanent body of water. Mr. Cooper at first took it to be a leech, and when he attempted to capture it it immediately commenced burrowing in the ground.'

"The larva reared by De Geer was terrestial. This larva is semiaquatic, for it is quite at home either in moist earth or water. My specimen was kept for over two weeks in a large earthen jar of moist earth well supplied with earthworms.

"It manifested no desire to come to the surface, but burrowed in every direction below. I found several pale, dead worms in this jar, though I can not say positively whether they had been killed and sucked by this larva. Mr. Walsh, in speaking of its haunts and its food, says:

FIG. 98.—*Tabanus atratus:* larva (from Hart).

"'I have, on many different occasions, found this larva among floating rejectamenta. On one occasion I found six or seven specimens in the interior of a floating log, so soft and rotten that it could be cut like cheese. Once I discovered a single specimen under a flat, submerged stone, in a little running brook. Finally, I once met with one alive, under a log, on a piece of dry land which had been submerged two or three weeks before, whence it appears that it can exist a long time out of water. I had on several previous occasions failed to breed this larva to maturity, and the only imago I have was obtained in 1861 from larvæ, which, suspecting them to be carnivorous from the very varied stations in which they had occurred, I had supplied with a number of fresh-water mollusks, but the habits of which, in consequence of having been away from home, I was unable to watch. On September 22, 1863, I found a nearly full-grown larva among floating rejectamenta, and between that date and December 23 he had devoured the mollusks of eleven univalves (genus *Planorbis*) from one-half to three-fourths of an inch in diameter; and on three separate occasions I have seen him work his way into the shell. In this operation his pseudopods were energetically employed, and I found, on cracking the shells after he had withdrawn, that a small portion of the tail end of the animal was left untouched—no doubt in consequence of his being unable to penetrate the small end of the whorl of the shell—and also the skin of the remaining part and the horny-tongued membrane.

"'My larva transformed to pupa within the ground during the fore part of July; it remained in this state but a few days and the fly issued July 13, and soon made its presence known by its loud buzzing inside the jar. It was a perfect specimen, and the pupal integument was sufficiently firm and polished, that by carefully washing off the earth an excellent cabinet specimen was obtained, which retained almost the exact form and appearance of a living pupa. Before the escape of the fly, which was effected through a longitudinal fissure on the back of the head and thorax, reminding one of the mode of escape of our harvest flies (Cicadæ), this pupa by means of the horns with which it is furnished had pushed itself up to the surface of the earth.'

"The pupa (fig. 97, *b*) is nearly an inch and a quarter in length and a third of an inch in diameter. It is cylindrical, slightly curved, as in the figure, rounded at the head and tapering at the extreme hind portion. The abdominal segments are all but the first one provided with a ring of fine yellowish bristles, pointed backward. There is a stout thorn at the anal extremity, bearing six other thorns.

"The pupa state lasts but a few days and before the emergence of the fly it is pushed to the surface of the ground by means of the bristles and thorns of the abdomen, with bending movements of the body.

"It splits along the dorsal line and the fly emerges, leaving the pupa case in very perfect condition.

"The adult fly (fig. 97, *c*) is an inch or more in length, black throughout, the back of the abdomen covered with a bluish white bloom and the wings smoky black. They are common through the summer months and it is possible from the different times that full-grown larvæ have been observed that there is more than a single brood in a year. It seems probable, however, that the winter is spent in the larval stage and that the full-grown larvæ observed by Mr. Walsh in September were simply late specimens that had lived over the previous winter and would have pupated the same fall, producing the flies a few days later, and these have laid eggs to pass the succeeding winter. Hart says the larvæ were taken every month of the season except June, at which time they had mostly reached the pupa or imago stage.

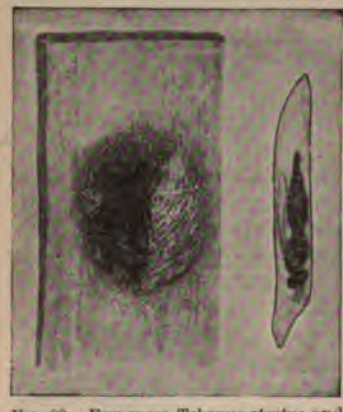

FIG. 99.—Egg mass *Tabanus atratus* and single egg containing parasite (from Hart).

"The habits of the adult have already been sufficiently stated, and as we have, unfortunately, no certain means of repelling them from cattle, so as to prevent the bites, which is the only thing we need fear from them, a discussion of remedies is unnecessary.

"It might be stated, however, that observations on the effect of tar and oil or

FIG. 100.—*Phanurus tabanivorus* Ashm. (from Hart).

other substances used to repel bot flies would be of value in arriving at some method of preventing their attacks.

"Hart records the rearing of parasites, *Phanurus tabanivorus* Ashm., from the egg masses of this species. Also the apparent parasitization of a larva.

GREENHEAD HORSEFLY.

(*Tabanus lineola* Fab.)

"This is generally regarded as the most common species in North America, and its occurrence in all parts of the country in large numbers fully supports such estimate.

"While it must have been a familiar pest to the early inhabitants of the country, its first scientific description was given by Fabricius. (Ent. Syst., Tom. IV, p. 369.)

"Packard (Guide to the Study of Insects, page 394), says:

"'This fly is our most common species, thousands of them appearing during the hottest part of the summer, when the sun is shining on our marshes and western prairies; horses and cattle are sometimes worried to death by their harassing bites. In cloudy weather they do not fly, and they perish on the cool, frosty nights of September.'

FIG. 101.—*Tabanus lineola* (from Packard's Guide).

"And also in Our Common Insects, page 74:

"'We were told during the last summer that a horse which stood fastened to a tree in a field near the marshes at Rowley, Mass., was bitten to death by these greenheads; and it is known that horses and cattle are occasionally killed by their repeated harassing bites.'

"This death of animals from bites must be very rare indeed, for in many years' residence in the Mississippi Valley, where the flies abound, the author has never known of such an incident, though the bites are certainly a great torment.

"The flies are brown, with a tinge of reddish, and the abdomen has a conspicuous whitish line along the middle. The eyes are a brilliant green, from which the name is derived.

"Hart has detailed the characters of the early stages as follows: 'The larva of this species closely resembles the young of *nigrescens*, and was not separated from it at first.' Examples of larvæ are said to have been collected in April and June, pupæ in May, and imagoes in May and June. 'The tabanid pupæ develop much more rapidly in hot weather than in cold, and to this fact is probably due the difference in time of emergence.'

FIG. 102.—*Tabanus lineola*: pupa, dorsal view—enlarged (from Hart).

"'Larva: Length, 20 mm.; diameter, 2.7 mm. Prothorax with lateral shining areas about as long as the dorsal area, striation about the same as that of the upper mesothoracic area; no noticeable central smooth spot; a small one on lower margin posteriorly; remaining lateral areas a little more finely and closely striate; dorsal and ventral areas of thorax nearly smooth on disk, with basal striæ; those on abdomen with moderately close striæ, more or less interrupted on disk; all areas more or less shining.

"'Surface whitish, dull pubescent markings very light brown but distinct, annuli narrow, crests of false feet also dull pubescent, their sides striate; lateral stripes of thorax distinct, slender, not dilated posteriorly, lateral edges of dorsal areas of thorax diverging; an opaque dark ring about the base of respiratory tube, and another encircling anal prominence, above it usually three light-brown spots.

"'Main internal tracheæ rather thick and noticeable, subparallel, not strongly sinuate, at least back of the middle. Terminal stigmatal spine often protruded.

"'Pupa: Length, 19 mm.; diameter, 3 mm. Light ferruginous brown, shining, abdomen roughly wrinkled and subopaque. Palpal sheaths indistinct, not distant; tubercles not dark; ocellar tubercles indistinct or wanting; thoracic spiracular tubercles (fig. 103) slightly but nearly equally elevated, free margin rounded at tip, rima not vertical, evenly arcuate, slightly hooked in front.

"'Abdominal spiracular tubercles subtriangular, narrower behind, obliquely subconical, much shorter than basal diameter, bearing a small subcircular or short and

strongly arcuate rima (fig. 104); on anterior slope a transverse groove, usually longer than the rima; fringes formed of unequal pale spines, only one or two long spines above on seventh segment; outer terminal teeth much longer than the others, directed laterally and upward, the tips of the four upper teeth about in line (fig. 105), fringe anterior to anal prominence showing a chitinous webbing between the bases of the spines, so that the separated tufts of the female look like a pair of broad, low teeth with several spiny points; lateral tufts low down, near ends of ventral fringe, formed of short spines.'—(Hart.)

"The species may be stated to have at least one natural enemy, for in the American Entomologist (Vol. II, p. 337) there is an account, by Mr. H. J. Dunlap, of their being eaten by the Nebraska bee killer (*Promachus bastardii* Macq.).

"This account is of considerable interest, and we quote it herewith:

"'*Champaign, Ill., August 6, 1870.*—I send you an insect by mail to-day in a glass bottle that has interested me for three or four years. I am hardly able to decide whether it is a friend or foe. My attention was first called to it by seeing several around my team during summer. Supposing them to be a new horsefly, I watched to see one bite, but was finally rewarded by seeing it pounce upon a greenhead (*Tabanus lineola* Fabr.). It settled upon my sleeve and soon had transferred the contents of Mr. Greenhead's body inside its own by sucking the juices out by means of its stout proboscis. I saw this operation repeated many times. The present summer I have seen them dozens of times, often five or six around my team, and have always noticed that in an hour or so after they appeared no more horseflies were to be found. I have also seen them 'sucking' house flies, lady bugs, chinch bugs, several moths, and have also seen them eat each other. The one sent you had just captured a honeybee, for which offense I made a martyr of him (or her) for the benefit of science.'

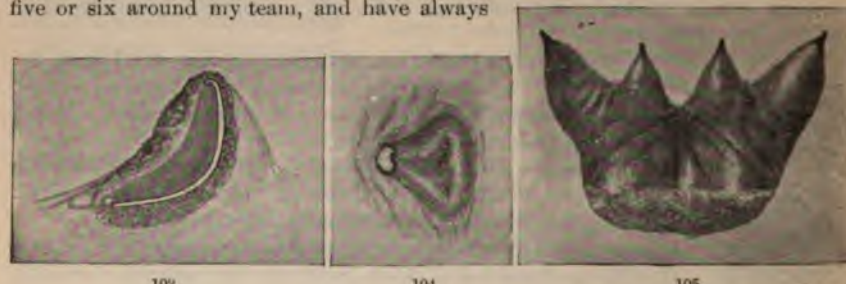

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FIG. 103.—*Tabanus lineola:* spiracular tubercle of pupa—enlarged (from Hart).
FIG. 104.—*Tabanus lineola:* abdomina. spiracle of pupa (from Hart).
FIG. 105.—*Tabanus lineola:* end of last segment of pupa (from Hart).

THE GREENHEAD.

(*Tabanus costalis* Wied.)

"This is another common species very abundant in the prairie States, and was described many years ago. It is probably about as abundant and widely distributed as *lineola*, and causes a great amount of annoyance and suffering to domestic animals.

"The following from Hart presents our present knowledge of the life history of the species:

"'This seems to be normally a terrestrial larva. We have taken it two or three times in the earth of cornfields in Champaign County. The dates given are May 31 and June 4. Examples were placed in a breeding cage and an imago of *costalis* was secured from them.

"'The imago, known as the 'greenhead,' is very generally common, and is quite a pest in some bottom-land prairies. A few examples were noted along shore at Station D, August 20. The examples in our collection were taken on twenty-two occasions, all between July 15 and August 13, except three dates, July 8 and August 18 and 31, which would make it probable that it is single brooded. The localities are Carroll, Lake, Cook, and Ford counties at the north, and Fulton, McLean, and Cham-

paign counties in central Illinois. The specimens were from a variety of situations, usually in low herbage, often taken visiting flowers.

"'Larva: Length, 20 mm.; diameter, 2.7 mm.; prothorax with lateral shining areas about as long as the dorsal, coarsely striate, a smooth spot near center of disk; dorsal and ventral areas of thorax smooth, a few striæ on those of metathorax, especially posteriorly; remaining areas moderately striate, lateral areas of abdomen a little more finely striate than the others; all more or less shining.

"'Dark annuli pale, narrow, longitudinal stripes scarcely present; false feet with dull pubescent crests, their sides rather finely striate; a narrow dark annulus at base of respiratory tubes, another round base of last segment, inclosing anal prominence and giving off a pair of lateral stripes, the lower one longer; no projecting spines seen.

"'Pupa (from defective cast skin of male): Length, 20 mm.; diameter, 3 mm.; light fuscous brown, shining; abdomen smoothly wrinkled; slightly opaque; prothoracic spiracular tubercles slightly but nearly equally elevated, free margin rounded at tip, rima not vertical, evenly arcuate, slightly hooked in front.

"'Abdominal spiracular tubercles small, subtriangular, narrower behind, obliquely subconical, much shorter than basal diameter, bearing a very small subcircular ring; fringes formed of unequal pale spines, the longer ones sparse on seventh segment above; outer terminal teeth twice as large as lower pair, directed laterally and slightly backward; upper pair smallest, directed upward; ventral fringe of last segment not noticeably webbed; lateral tufts rather high, not near ends of ventral fringe.

"'My material of this species is not in best condition for accurate comparisons.'

Tabanus annulatus Say.

"This species was described by Say in 1822 (Jour. Acad. Phil., Vol. III, p. 31; Comp. Writ., Vol. II, p. 53), and its territory stated as Missouri.

"It does not seem to have received special notice since.

"It is probably not abundant enough to cause serious annoyance to stock or is commonly confused with some more common species and has consequently received little attention.

"It is smaller than *Tabanus lineola*, the length of the body being a little more than two-fifths of an inch.

"It is of a leaden-gray color tinged with reddish; the abdomen blackish brown with gray margins to the segments, the wings without spots and slightly dusky. (From Say's description.)

Tabanus stygius Say.

"This species is almost as large as *Tabanus atratus* Fab., nine-tenths of an inch in length, and occurs in the Mississippi Valley. Say's description in 1822 (Jour. Acad. Nat. Sci. Phil., p. 33) locates it in Arkansas.

"It is violet black and with the thorax pale chestnut. The front of the head is yellowish, the thorax with five gray lines, the wings rusty with three brown spots. (From description of Say.)

"It is fairly common at Ames, Iowa, but has not been observed as especially annoying to stock. It has a wide range, however, and deserves to be studied with reference to its early stages.

"Hart gives the following facts concerning the species, with descriptions of early stages:

"'The present species was the most abundant tabanid larva in the vicinity of Havana last spring (1895). It first appeared in our collections September 14, when a number were noted swimming amidst vegetation near the margin at Station B. In the spring they were found at nearly all of the stations, but more particularly in connection with tipulid, muscid, and Eristalis larvæ, in matted accumulations of dead stems and leaves over mud. They were especially abundant March 30 in Flag Lake, where large plump larvæ appeared at every turn. It was a surprise to find a few of them upon the bottom in open, shallow water, far from shore, in the middle of Quiver Lake at Station A. Young larvæ have been common in connection with larvæ of

Bittacomorpha and *Limnophila* at Station I since March 17. At Stations B and G they have been common in moist drifts of fine rubbish washed up by waves. Pupæ were found in the breeding cages May 10 and 23. One emerged May 27 and another tried to emerge June 2, but died and was removed from its case.

FIG. 106.—*Tabanus stygius:* larva (after Hart).

"'The larvæ resemble those of the *lineola* group in their striation and coloration, but differ in their short lateral prothoracic areas and larger size. They are like *atratus* in size, but may be readily separated from it by their coarser lateral striation, straw-yellow tint, slender lateral vittæ, and usually projecting terminal stigmatal spine.

"'Larva: Length, 45–55 mm.; diameter, 6–7 mm.; bright straw yellow, varying in some young larvæ to nearly clear white, marked with light fuscous brown microscopic pubescence, usually paler at each stage than *atratus*.

"'Lateral prothoracic striated areas not more than half as long as the dorsal, striation not finer than that of the middle and lower lateral areas of the mesothorax, striated portion shining; a small smooth spot adjoining the impressed line below; remaining upper thoracic areas a little less closely striated, but not strongly different from that of the prothorax; abdominal lateral areas a little more finely striate; dorsal and ventral areas with margin striated, disks nearly smooth in adult larvæ, last segment more strongly striate, especially beneath.

"'Dark annuli distinct, broad, including false feet, a distinct, transverse dorsal and ventral pale spot in front of the false feet; abdominal annuli often with a small triangular backward prolongation on median line above. Prothoracic lateral space occupied by a pale brownish fuscous quadrate spot in front of the striated space. Meso- and meta-thoracic lateral stripes usually distinct, but slender, scarcely dilated posteriorly, lateral edges of dorsal areas diverging; lateral stripes above the abdomen almost wanting, except on last two segments. In these stripes the punctures of the upper and lower rows are indicated by rounded pale dots, and those of the inner rows by elongate dots. Last segment with bases of respiratory tube and anal prominence encircled with dark rings, joined by a lateral connection, its dorsum with at most a short basal line or pair of dots on each side. Coarser pubescence of false feet tipped with pale brownish.

"'Main internal tracheæ thick and noticeable, especially in young larvæ, lustrous, subparallel, not strongly sinuate, nearly straight posteriorly; terminal stigmatal spine dark reddish brown, smooth, usually protruded (fig. 107, p. 106).

"'Pupa ♀: Length about 30 mm.; diameter about 6 mm.; light brownish fuscous, thorax paler, shining; abdomen roughly transversely wrinkled and subopaque. Palpal sheaths distinct, as far apart as are the setæ borne by the larger tubercles at the center of the anterior surface of the head; surface between them rounded, bearing a small wrinkled tubercle at middle; antennæ and tubercles darker than surrounding surface; ocellar tubercles distinct; prothoracic spiracular tubercles slightly but evenly elevated in a plane parallel with that of the surrounding surface; rima nearly straight in its outer half, inwardly curving strongly forward and ending in a conspicuous hook; free margin of tubercles rounded at tip.

FIG. 107.—*Tabanus stygius:* last segment of larva, side view, showing projecting spine—enlarged (from Hart).

"'First abdominal with two distinct setæ each side above the spiracles; abdominal spiracular tubercles rounded, broad behind, low, subhemispherical, rima long, following posterior border of tubercle, slightly curved at middle, more strongly curved forward at each end; on anterior surface a transverse groove extending across the tubercle, but not as long as the rima. Fringes of unequal spines, often tipped with blackish, all but two of the long spines wanting in a broad space above on seventh segment. Terminal teeth nearly equal, tipped with blackish, their points marking the angles of a hexagon, slightly wider than high. Ventral fringe of last segment not webbed together; lateral tufts high, on a level with upper lateral line.'

Tabanus molestus Say.

"In describing this species in 1822 (Jour. Acad. Phil., Vol. III, p. 31; Comp. Writ., Vol. II, p. 53) Thomas Say states:

"'This is one of the species that are called prairie flies. It is numerous in the prairies of the State of Missouri and is very troublesome to the cattle. I have seen cattle in the forests which margin these prairies when attacked by these insects start suddenly and plunge into the thickets that the branches may divest them of their enemies. Travelers are much incommoded by them; many cover their horses with canvas, etc., to shield them from their attacks, or rest in some shaded or secluded situation during that part of the day when they are the most abundant.'

"No special mention is made of it in subsequent works, but we know it to be fairly common in the Mississippi Valley. Say's account probably covers territory outside of the present State of Missouri; and Wiedemann (vide O. S. Cat., p. 22) is authority for its occurrence in Kentucky.

"It is a rather large species, nearly four-fifths of an inch long; the thorax gray, with brown lines; the abdomen black-brown with a gray central stripe, which is widened on the middle segments and consists of triangular spots on the fourth, fifth, and sixth segments.

EUROPEAN GADFLY.

(*Tabanus bovinus* Linn.)

"From the statements of European writers this is apparently *the* gadfly of Europe, or at least the one which is particularly troublesome to cattle.

"According to Linnæus (Syst. Nat., Turton Transl., Vol. III, p. 67), it inhabits Europe, and is extremely troublesome to cattle.

"The eyes are greenish; back of abdomen with white triangular longitudinal spots.

"The early stages of this species were traced by De Geer (Mem. Ins.), who found the larva to be terrestrial and carnivorous. His observations on this species were the first giving information upon the early habits of the Tabanidæ.

THE BANDED BREEZE FLY.

(*Therioplectes cinctus* Fab.)

"The banded breeze fly, or orange-belted horsefly, is a species of somewhat larger size than the greenhead. It is rather less abundant than the black breeze fly, which it somewhat resembles, excepting the orange or reddish band on the abdomen. It is limited more to the Eastern States. It was described by Fabricius at the same time as *Tabanus atratus* (Ent. Syst., Vol. IV, p. 366).

Hæmatopota pluvialis Linn.

"According to Kollar this is one of the most troublesome species. He says:

"'It is not much larger than the common horsefly, and is chiefly distinguished by its large green eyes, through each of which run four brown undulating bands.

"'The body is gray with brownish cross stripes; the wings gray with brown spots. It frequents meadows and pastures and attacks horses and horned cattle in sultry weather before rain, nor does man escape. Although the wound it inflicts is sharp, it does not produce any lasting itching or burning.'

"This statement regarding the injury caused does not agree entirely with the statements of other authorities, for in Kirby and Spence's Entomology (p. 93) we find a quotation from MacLeay which reads as follows:

"'I went down the other day to the country, and was fairly driven out of it by the *Hæmatopota pluvialis*, which attacked me with such fury that, although at last I did not venture beyond the door without a veil, my face and hands were swollen to that degree as to be scarcely yet recovered from the effects of their venom. I was obliged on my return to town to stay two days at home. Whenever this insect bites me it has this effect, and I have never been able to discover any remedy for the torture it puts me to.'

"Also, in Linnæus under the description of the species:

"'Like *T. excutiens*, this little insect fixes on the hands, face, and legs, exciting a painful inflammation in the part where it has drawn blood.'

FIG. 108.—*Chrysops vittatus:* larva (after Hart).

THE EAR FLY.

(*Chrysops vittatus* Wied.)

"This is a rather small species, yellow in color, with black stripes and a broad, smoky band across the middle of each wing. It was described in 1821 by Wiedemann, but without reference to its habits.

"It is said to be very troublesome in the wooded regions of the Mississippi Valley, directing its attacks particularly upon horses' ears, in consequence of which it is commonly called the 'ear fly.'

Chrysops univittatus Macq.

"This is a common species in the prairie region and is recorded from District of Columbia, Maryland, Connecticut, New Jersey, and Kentucky by Osten Sacken. It appears to be the most common species at Ames, Iowa.

Chrysops niger Macq.

"A similar species, black in color; also very common.

Chrysops quadrivittatus Say.

"Say described this species in 1822 as inhabiting the region near the Rocky Mountains. It is of a gray color, with four longitudinal brown lines on the thorax. The wings have a large brown spot on the front margin. It is nearly two-fifths of an inch in length.

Chrysops costatus Fab.

"Occurs in South America and the West Indies.

Chrysops fugax O. S.

FIG. 109.—*Chrysops univittatus* (original, from drawing by Miss L. Sullivan).

"This species, easily recognized from the figure, is widely distributed. Osten Sacken recorded it from Maine, New Hampshire, Canada, Idaho, Montana, and Yukon River. It occurs at Ames, Iowa, and doubtless throughout the northern Mississippi Valley at least.

THE HIPPOBOSCID-LIKE TABANID.

(*Goniops hippoboscoides* Aldrich.)

"Under the above name Mr. J. M. Aldrich has described a very peculiar fly, that has the structure of the tabanids, but the general appearance of a hippoboscid, although it is not known but only surmised that it may have a parasitic or semiparasitic habit.

"Since nothing is known as to the habits or the early stages of the species, and it would seem to be of very rare occurrence, it will suffice for the purpose of this paper simply to refer to the original description and figures (Psyche, Vol. VI, pp. 236, 237)."

FIG. 111.—*Chrysops fuyax* (original, from drawing by Miss L. Sullivan).

FIG. 110.—Egg mass of *Chrysops æstuans* (from Hart).

THE STABLE FLY (STOMOXYS CALCITRANS).

FIG. 112.—*Stomoxys calcitrans:* Adult, larva, puparium, and details—enlarged (original).

[Dr. Curry's observations mentioned on page 49 make it advisable to add a few words regarding the biting stable fly (*Stomoxys calcitrans*). This insect is somewhat similar to the common house fly (*Musca domestica*), for which it is frequently mistaken. Despite its name, it is not confined to stables, but frequents also groves and even houses, sometimes biting man and causing considerable annoyance. It is, in fact, this insect which has given rise to the popular idea that flies bite before a rain. It breeds in dung, so that a proper disposition of the manure, as suggested on page 98, will prevent its undue increase. This fly is very common, and has a wide geographical distribution.]

NAGANA, OR TSETSE-FLY DISEASE.

In connection with surra it will be of interest to the reader to be able to compare some of the recent results obtained from the study of nagana, or tsetse fly disease. To supply the necessary data we append here an account of the investigations recently published by Kanthack, Durham & Blandford (1898a, pp. 100–118). The report is reprinted in full, as it is not generally accessible to physicians and veterinarians here and in the Philippines.

"On nagana, or tsetse fly disease. (Report made to the Tsetse Fly Committee of the Royal Society of Observations and Experiments, carried out from November, 1896, to August, 1898.) By A. A. Kanthack, H. E. Durham, and W. F. H. Blandford.

"At the request of the Colonial Office, the Royal Society of London appointed a committee to cooperate with Surgeon-Major Bruce in his research upon nagana, or the tsetse fly disease. This committee intrusted us with the actual experimental work. The object was to study nagana systematically in ordinary laboratory animals, to investigate the life history of the hematozoon discovered by Bruce, and, if possible, to discover methods of prevention, cure, or immunization.

"The material for our observations was obtained in the first instance from the blood of a dog infected by the disease on the voyage from Africa, and brought to England in November, 1896, by Dr. Waghorn.

"The investigation was begun at once at the pathological laboratory of St. Bartholomew's Hospital, but in February, 1897, was transferred to the pathological laboratory of the University of Cambridge.

"*The Hematozoon* of nagana has already been described by Bruce, and is closely allied to the *Trypanosoma* of surra. We have had no opportunity of studying the latter disease, the relation of which to nagana is referred to later. The parasite discovered and described by Rouget[a] in a horse in Algeria is also similar. In English sewer rats (*Mus decumanus*) a *Trypanosoma* (*T. sanguinis* [*T. Lewisi*]) is occasionally found, but this is quite distinct from the hematozoon of nagana, both in its morphological appearance and in its pathogenic effects (*vide infra*).

I. Susceptibility.

"Cats, dogs, mice, rabbits, rats, both sewer rats (*Mus decumanus*) and white and piebald rats (*Mus rattus*), are highly susceptible, and in these animals the disease has proved fatal in every case of infection which has been allowed to run to a close.

"A single *hedgehog* inoculated was readily infected and died in 17 days, so that this animal probably possesses a high susceptibility.

"A single *donkey* was inoculated and was killed 12 weeks later, being then in a weak condition and near dying.

"Two *horses* have been inoculated, one a strong and well-fed cart horse (Russian), which survived 7 weeks, the other a rather old animal (see under zebra hybrids), which survived only 8 days.

[a] Annales de l'Institut Pasteur, 1896, p. 716.

"A *bosch-bok* has also been inoculated; it died 7 months afterwards without showing any lesions. All the inoculations made from it proved negative.

"Two hybrids of zebra and horse (♂ zebra and ♀ horse, and ♂ horse and ♀ zebra) and one hybrid of zebra and ass (ass ♂ and ♀ zebra) have also been inoculated. These were kindly put at the disposal of the Royal Society by Prof. Cossar Ewart, of Edinburg, in order to see whether such hybrids are refractory to nagana.

"The two former were infected by plunging a needle wetted with nagana blood beneath the skin; the latter received a dose of 1 c. c. of the same blood. All of them died in about 8 weeks. During the course of the disease they showed irregular rises of temperature, sometimes up to 41.6° C. Variations in the number of hematozoa were ascertained in the case of the horse hybrids; on some occasions they were abundant (66,000 per c. m.). Whenever the donkey hybrid was examined at the earlier stage of the illness, the hematozoa were found to be either scanty or absent. A horse which was inoculated as a control died in 8 days, with very abundant hematozoa in its blood; this animal must have been peculiarly susceptible to nagana, as no other cause for death could be found at postmortem examination. There is no reason for supposing that the hybrids exhibited any more refractoriness than other horses or asses.

"Koch[a] reports on attempts which he made to infect two Masai donkeys, and two crosses from Muscat and Masai donkeys. None of these showed any symptoms of the disease up to 3½ months, nor were hematozoa discovered in their blood at any time, although repeated examinations were made. Consequently there is no proof that these animals were really infected. In our experience scratch inoculations sometimes, though rarely, fail; on the other hand, inoculations by puncture with a needle or by actual injection do not fail; Koch's animals were inoculated by the scratch method. It should be added that all his control infections were successful. He did not find that ordinary mules showed any immunity.

"With regard to *guinea pigs*, at first we thought that they were refractory under normal conditions, and that it was possible to infect them only after their resistance had been reduced by bleeding or other interferences.

"We found, however, that guinea pigs are susceptible to nagana under ordinary conditions, but that, as a rule, the disease in them is more protracted than in rabbits, rats, mice, cats or dogs, and even horses; so that they are distinctly more resistant than these animals. In no instance, however, has recovery ensued after hematozoa have once appeared in the blood.

"According to unpublished observations by Bruce upon the tsetse fly disease in South Africa, it appears that native *goats* and *sheep* are to some extent refractory, the disease, as a rule, running a chronic course (five months).

"A *monkey* (*Macacus rhesus*) was also tried. It died in about 2 weeks in an advanced condition of pulmonary tuberculosis, but the presence of abundant hematozoa had been determined in the blood during life up to the time of death.

"A *weasel* was injected. It showed hematozoa in its blood, and died a few days later, but death almost certainly was hastened by the effects of captivity.

"Pigeons are the only *birds* which have yet been tried. The pigeons after inoculation did not show signs of the disease, nor was their blood infective. It may be mentioned that Bruce tried South African *hens* without success. Further experiments with birds are in hand.

"*Young animals*, if susceptible (kittens and puppies), as a rule, have died earlier than adults, and while suckling they are still more highly predisposed; young guinea pigs, however, are comparable to older ones in their resistance.

"The *fetus in utero* of infected rabbits, guinea pigs, or rats is not infected, although the mother's blood may contain a large number of hematozoa. The latter are to be found in the placenta, but not in the fetal blood. Similar observations have

[a] Reiseberichte [1898a], pp. 69 and 88.

also been made by Lewis,[a] Lingard,[b] and Rouget[c] in their investigations on allied hematozoa.

II. Duration of disease in the different animals.

"As will be seen from the figures given below, the lethal period varies somewhat in each species of susceptible animal. The duration of the disease appears to depend principally upon the individual susceptibility rather than on the mode of inoculation or the quantity of infective material introduced. Thus, of 4 rabbits inoculated in the same manner with the same material, 3 died on the twelfth, twenty-first, and twenty-fourth days, respectively, while the fourth was killed on the forty-first day; many similar instances could be cited. Nor does a larger quantity necessarily determine a more rapid death; thus, a rabbit which has received the whole blood of another rabbit containing numerous hematozoa may survive longer than the minimal lethal period for rabbits. We have not been able to define the conditions which determine these variations in susceptibility. Rouget has noted similar variations in the lethal period.

"The ratio of the minimal to the maximal lethal periods is about 1 to 5 or 1 to 6 in rabbits and rats, and 1 to 9 in guinea pigs. The number of other animals inoculated has not been sufficiently great to determine a satisfactory ratio.

"In our experiments dogs survived an infection 14 to 26 days, cats 22 to 26 days, rats 6 to 26 days, mice 8 to 25 days, rabbits 13 to 58 days, and guinea pigs 20 to 183 days; the average duration being for dogs 18 days, for cats 24 days, for rats 12 days, for mice 13 days, for rabbits 30 days, and for guinea pigs 50 days.

"Since the commencement of these experiments a large number of animals have been dealt with, and thus an extensive series of cross inoculations has been carried out; but we have found that the duration of the disease is not dependent on the kind of animal from which the hematozoa are derived. No constant modification is therefore effected by passages, either in the direction of attenuation or of increased virulence. This statement is completely borne out by Bruce's observations on wild animals, as well as African sheep and goats, for he found that the hematozoa of these animals were as infective as those obtained from highly susceptible animals, such as dogs.

III. Mode of inoculation.

"Inoculations have been made with the blood of an infected animal subcutaneously, intravenously, or intraperitoneally, or by applying a minute and often minimal quantity of infected blood to a superficial scratch. Rabbits have also been inoculated in the anterior chamber of the eye; and rats directly into a lymphatic gland.

"Blood taken from diseased animals, although showing no hematozoa when examined microscopically, has frequently been proved to be fully infective, so that it appears that a single hematozoon or at any rate a very small number of them, successfully introduced, are capable of producing the disease. At present no method of graduating the dose appears possible, since a minute quantity is as effective as much larger quantities, though the lethal period may be somewhat prolonged. It is also possible that unrecognized forms are present in these cases, though it should be added that in some instances where no hematozoa are found in simple films we were able to detect them by means of centrifugalizing the blood.

"Successful inoculations have also been made with lymphatic gland, spleen, bone marrow, aqueous humor, serous fluid, edema transudation, and testicular juice.

"The incubation period and the duration of the disease, as already pointed out, are not entirely dependent upon the number of hematozoa in the material injected,

[a] Physiol. and Pathol. Researches [1888], p. 630.

[b] Summary of Further Report on Surra, 1895 [p. 12].

[c] Annales de l'Institut Pasteur, 1896, p. 716.

or the source of the infective material. Thus, the hematozoa of lymphatic glands, etc., are as infective as those of the blood. The duration of the disease is not materially affected by the mode of inoculation adopted, and is about the same whether the infection was brought about by subcutaneous, intravenous, or intraperitoneal injection, or by a superficial scratch.

"Material taken from the bodies of animals twenty-four hours or sometimes less after death is hardly ever infective, even when several cubic centimeters are injected, so that we have no evidence of a resisting or sporing form which survives in the tissues or blood of the dead animal and is inoculable into other mammals. It must be added that putrefactive changes often set in with great rapidity in the bodies of animals dead of nagana.

"Blood drawn from the living infected animal and kept *in vitro* in an aseptic condition retains its infective power *at most* for 3 or 4 days, but this period is generally less. Complete drying also renders blood noninfective.

"Blood heated to 50° for 30 minutes invariably becomes noninfective, even in large doses (such as 4 c. c.), while, when heated to 46° C. for half an hour, it proved infective in one out of two cases, although apparently the hematozoa had become nonmotile—at least no motile forms were detected under the microscope. But even in this case the lethal period was not prolonged.

"Infection by feeding has been attempted by means of a number of experiments. Sometimes it was successful—in most cases unsuccessful; so that it has seemed to us that the possibility of infection by the mouth depends on accidental lesions about the mouth, nose, ears (in rats), or alimentary tract.

"Of a number of rats fed on organs of nagana animals only a few acquired the disease, and these invariably showed superficial lesions of the snout and ears due to lice. When fed upon infective material, they bury their snouts in it as well as scratch their ears with their blood-stained forepaws. Furthermore, in the rats which acquired the disease through feeding, the cervical glands were always enlarged most, which proves that the hematozoal infection must have taken place in the head, for, as we shall show, the primary infection travels by the lymphatics.

"A cat fed repeatedly on soft tissues of the bodies of infected dogs and cats, and subsequently on the bodies of dead rats, died at a time corresponding by lethal period to an infection at the first meal on rats. We regard it as probable that some splinter of bone caused a superficial lesion through which the hematozoa were enabled to enter.

"One rabbit, fed carefully by means of a pipette with large quantities of infected blood, never showed the slightest sign of the disease. Rouget (1896) also failed to infect animals by the mouth.

"Two rabbits, into whose conjunctival sacs several drops of blood containing very abundant hematozoa, and a third rabbit whose eye was brought into contact with one of these, did not become infected. We presume that Rouget's positive results by this method were due to some accidental lesion.

"A dog suffering from the disease did not infect her puppies during the last 14 days of her life, nor did these puppies infect their foster mother (she cat) after they had been inoculated.

"Nor have we observed transmission of the disease through the mother's milk in guinea pigs. Rouget alludes to a doubtful instance of infection by coitus in rabbits by means of the spermatic fluid. We have not detected hematozoa in spermatic fluid obtained from the vesiculæ seminales, and believe that in Rouget's single positive case there may have been direct infection from the penis, which suffers considerably in rabbits and may become excoriated, so that it easily bleeds.

"We therefore do not believe that it is possible to infect an animal by feeding in the absence of superficial lesions, and in this respect we differ from Bruce, who seems to imply that the hematozoa can pass through the unbroken surface of the alimentary tract.

IV. Symptoms and course of the disease.

"These vary somewhat according to the nature of the animal, but there are certain striking symptoms which commonly occur in different groups of animals. These may therefore be regarded as the most characteristic.

"1. *Muscular wasting* and *loss of power* are evident in all but the small animals. In rats, mice, and guinea pigs they are but little marked or absent altogether. In the horse, dog, cat, and rabbit the wasting is very conspicuous. In the cat, dog, rabbit, and hedgehog there is marked loss of weight, amounting to 20 to 30 per cent.

"2. *Fever.*—In most animals which have been examined there is a smart rise of temperature about the time of appearance of hematozoa in the blood. (Horse, 41.5° C.; dog, 40° C.; rabbit, 41° C.; guinea pig, not constant.)

"Paroxysms of fever are common in the *horse*, as has already been shown by Bruce. The temperature may rise to a considerable height (41.6° C.). The same is true of the zebra-horse hybrids. In a horse upon which daily observations were made, quick and sudden rises of temperature immediately followed an increase of the hematozoa in the blood. At the time of death there was marked pyrexia.

"In the single *donkey* which we examined the temperature was generally raised throughout the course of the disease.

"In *dogs* there is also fever, the temperature becoming subnormal on approach of death.

"In *rabbits* pyrexia is common, and generally the temperature is elevated throughout the disease, but it may fall suddenly to normal. The temperature curve is always irregular, and no relation between the temperature curve and the hematozoal curve could be established.

"In *cats* also the fever is well marked, the temperature falling quickly toward the end.

"It is difficult to speak with certainty of the temperature in such small animals as *rats* and *mice*.

"In *guinea pigs*, representing less susceptible animals, fever as a rule is not a special feature. The temperature is as irregular as it is in the normal animal, but the animal shows paroxysmal rises from time to time, sometimes above 41°. These may be accompanied by an accession of hematozoa into the circulation, but this is not a constant feature.

"3. *Edema* is common in certain animals, such as the horse, rabbit, cat, and dog, and is most marked about the head, legs, belly, or genitals. In smaller animals, such as rats and mice, it is not usual, and in guinea pigs it has not been observed. In dense tissues, as the rabbit's ear, there may be a local edema at the site of inoculation.

"Rabbits exhibit a special tendency to edema of the external genital organs. There is often great and progressive swelling of the prepuce or labia, as the case may be. The swollen parts often excoriate and become sore and covered by crusts, so that the animal is in a sorry condition.

"4. *Changes in the eyes and nose.*—In cats, dogs, rats, and rabbits turbidity of the aqueous humor, fibrinous plaques in the anterior chamber, and corneal opacities are occasionally observed. In rabbits a mucopurulent conjunctivitis is common, and this may be followed by an opacity of the cornea and a turbidity of the aqueous humor, which under such conditions shows hematozoa microscopically as well as leucocytes. Hematozoa have also been discovered in the conjunctival discharge in the earlier stages of the disease. Vascular corneal ulcers sometimes occur in dogs, and the conjunctivitis of cats, dogs, rats, and rabbits is frequently associated with edema of the eyelids and face. In rabbits the eyelids and nose frequently become almost entirely closed up by the drying of the secretion. In the latter case they breathe with great difficulty, keeping their mouths open. This condition has been described by Ronget (1896).

"5. *Anemia.*—Some degree of anemia is always present, but it does not seem to be so extreme as to be the sole attributable cause of death, and points rather to a disturbance in the hematopoietic or the hematolytic mechanisms.

"The number of red-blood corpuscles steadily diminishes and nucleated red corpuscles (normoblasts) often appear, especially in rats. According to observations on rabbits, the diminution of hemoglobin is roughly proportional to that of the blood corpuscles.

"Leucocytosis is not a constant feature and when present is apparently due to the febrile temperature. An excessive leucocytosis, such as occurs in leukemia, was never observed; 15,000 to 34,000 leucocytes being the highest numbers recorded per cubic millimeter.

"Blood drawn from an animal seriously ill, when clotted, generally exhibits a marked buffy coat; the serum is often turbid and may undergo secondary clotting.

"Instead of forming rouleaux, the red corpuscles tend to clump into masses and to lose their outlines, especially when the anemia is pronounced (rabbit, ass, and horse).

"The serum of such blood, when mixed with normal blood of the same species of animal, causes the red corpuscles to clump together also.

"The urine of infected dogs spectroscopically examined often shows an intense urobilin band.

"Wounds do not heal well, and tend to break down and become septic, even though the operation has been performed with strict aseptic and antiseptic precautions. The hematozoa may be abundant in the discharge from the wounds. Many animals, especially dogs, are apt to become infected with pyococci and other bacteria in the later stages of the disease, even when the inoculated material has been proved to be free from bacteria. We conclude that a spontaneous terminal bacterial infection may occur when the marasmus has reached a certain degree. This may accelerate death and is probably fairly often the case in the naturally acquired disease. But we have often proved by cultures that bacteria are absent in uncomplicated cases of experimental inoculation.

"7. A voracious appetite has not been observed in the infected laboratory animals; some animals refuse their food and the stomach is not seldom empty after death.

"8. Rats and guinea pigs often exhibit convulsive or eclamptic seizures shortly before death, but otherwise guinea pigs, rats, and mice show no symptoms of disease, except dullness in the later stages.

"9. Transmission from one animal to another, without direct inoculation, has never been observed. Nor have we come across instances of infection by coitus or through suckling, although we have dealt with large numbers of animals.

V. *Morbid anatomy.*

"In *rats* and *mice* exactly the same conditions may be observed. The most striking changes are:

"(1) Enlargement of the lymphatic glands, the glands corresponding to the seat of inoculation being always largest. This observation is important, because from the relative size of the glands it is possible to determine the seat of infection. To this allusion has already been made, when the effects of feeding were discussed. The glands are generally red, congested, juicy, and edematous; in a few instances hemorrhagic extravasation has been observed. In some cases all lymphatic glands in the body are enlarged, in others a particular series only. If a rat be inoculated in the right thigh, the glands in the left axilla and left groin suffer last.

"(2) The spleen is much enlarged, with but few exceptions, and it is generally firm, friable, and dark colored.

"(3) The liver generally shows some enlargement and may be fatty.

"(4) Wasting of the muscles and atrophy of the fat is, as a rule, not well marked.

"(5) Subpleural ecchymoses are sometimes present in the lungs, accompanied by a small amount of pleural fluid.

"In *rabbits* the general enlargement of lymphatic glands is less noticeable. The spleen is generally enlarged. Petechial ecchymoses are rare. Fatty degeneration of the liver is always present, and muscular wasting is often extreme. Enlargement of testes has been observed.

"In *dogs* muscular wasting is well marked, the animal being often reduced to a skeleton, but the fatty tissues are generally not much affected, except at the base of the heart, where the fat may undergo edematous degeneration. The general enlargement of the lymphatic gland is well marked, and, as in the rat, the glands are edematous and congested, yellowish, or even show hemorrhagic extravasations.

"The spleen is also greatly enlarged, granular, firm, and friable.

"Pericardial effusion is common; pleural effusion may be present.

"Subpericardial petechiæ and hemorrhages occur frequently, subperitoneal occasionally, and sometimes also submucous in the intestines and stomach.

"In *cats* wasting is pronounced, the glands are greatly enlarged, the spleen is also enlarged, the liver is slightly enlarged. Hemorrhages beneath the pleura and pericardium have been noticed.

"In *guinea pigs*, which clinically often show no changes or symptoms at all, the morbid changes after death are not very well marked. The spleen is generally moderately enlarged, and occasionally even considerably; it is often very soft and rather pale. The lymphatic glands are distinctly, but as a rule only slightly, enlarged, those corresponding to the seat of inoculation being always the most affected.

"Hemorrhages have been observed in the lungs and in the stomach; serous effusions and edema have not been noted.

"In all these animals the bone marrow is sometimes dark red in color, at other times natural, or paler than it should be. In the shafts of the long bones the fat disappears and becomes replaced by 'red' marrow.

"In many cases an iron reaction has been obtained with the liver, spleen, and kidney (ammonium sulphide; and K_4FeCy_6 + HCl).

VI. Distribution of hematozoa.

A. Blood.

"After a latent period of some days, hematozoa are invariably found in the blood at some time or other during the course of the illness.

"1. *Rats.* When the animal is inoculated with small quantities of infective blood, the latent period averages 3 to 4 days. When, however, a large number of hematozoa is inoculated into the peritoneal cavity, the parasites may be found in the blood even after a few hours.

"When the hematozoa have once appeared in the blood, they are generally found therein to the end, gradually increasing in number till the blood literally teems with them. During the early stages of the disease, however, variations are frequently noted, inasmuch as an increase on one day may be followed by a marked decrease on the next. In a few cases they have even temporarily disappeared from the circulation for a day or two, but this is distinctly rare in rats and mice, although common in other animals.

"At the later stages the hematozoa may amount to 2,000,000 to 3,000,000 per c. m.

"2. *Mice.*—What has been said of rats applies also to mice.

"3. *Rabbits.*—In these animals, after inoculations with minute quantities of blood, the parasites first appear in the blood in about 8 days, about the same time as the pyrexial attack. They remain in the general circulation for a day or two in small

numbers; this is followed by a disappearance and reappearance for a variable number of days at irregular intervals. In the animals which have been systematically examined the hematozoa do not appear abundantly until toward the close of the disease; the largest number which has been estimated near the time of death has been 60,000 per c. m. (compare rats and mice), but even at that time they may be scanty and difficult to find. They are also to be found in the fluid of the local edema and discharge from wounds, conjunctiva, or genitals. Although hematozoa may be so scanty that they can not be discovered by the microscope (sometimes even after centrifugalizing), the animals show marked clinical symptoms. Their blood has often been proved to be infective.

"4. *Dogs.*—Early in the disease, from 4–6 days, the hematozoa may be absent from the blood, but observations on their presence during life in the lymphatic glands have not been made. Toward the end they become very numerous (100,000 to 300,000 per c. m.). Variations in the number of hematozoa are common, but as a rule hematozoa are numerous throughout the disease.

"5. *Cats.*—The latent period is about 5 days; then the hematozoa appear in the blood, and, with daily variations, quickly increase in number. The variations are sometimes remarkable; thus on one day the hematozoa may be extremely numerous, while on the next day they will have become scanty.

"6. *Horse.*—Systematic observations on this animal, as well as on the donkey, have been made by Bruce. In our first horse the latent period was 7 days. The first appearance of hematozoa in the blood was followed by a sharp rise of the temperature. After the hematozoa once showed themselves they were generally scanty and often absent (the centrifuge was not used), but an appearance of the hematozoa in the blood was generally followed immediately by a paroxysm of fever. A few days before death, however, the number increased greatly, falling again to zero 2 days before death and being low at the time of death.

"7. *Guinea pigs.*—After a subcutaneous inoculation, a few hematozoa will generally be found in the blood about the fifth to seventh day. They may then again disappear and reappear from time to time, to disappear again after a few days. This alternation may go on for weeks. Then suddenly the hematozoa become numerous and gradually increase, sometimes with irregular variations, till the blood is almost crowded, 200,000 to 500,000 per c. m. being present. The guinea pigs die, generally without showing any symptoms, except perhaps convulsive attacks a day or two before death.

"In some cases no hematozoa have been found in the blood for over 6 weeks, although it has been examined daily. They then appeared in small numbers, and after remaining scarce for a week or so, suddenly and rapidly increased as the disease approached its fatal termination. It is, however, more common to find a few hematozoa about a week after inoculation, this being followed by a more or less prolonged period of absence.

"In cases where the disease runs a less protracted course, the hematozoa become numerous about 4 weeks after the inoculation, when they are often present in large numbers; but, as in the case of other animals, the number of hematozoa may be very variable, being almost enormous one day and very considerably less, or even very small, the next. In a case where the guinea pig had been bled before inoculation the disease ran a rather short course; hematozoa appeared 9 days after the infection, rapidly rising in number to over 128,000 per c. m., the animal dying after 22 days. In a few cases where the lymphatic gland corresponding to the seat of inoculation was examined, hematozoa were found in the gland, while they were absent in the blood.

B. Lymphatic glands.

"In the rat the superficial lymphatic glands may be readily examined by piercing them with fine capillaries or sharp needles; they may also be excised and examined more thoroughly. Although a considerable number of observations have been made

by these means, and also after killing the animals at various periods after inoculation, we wish to speak somewhat guardedly, since the appearances are not quite constant. Moreover, we are at present unable to be certain that unrecognized developmental forms have not been overlooked.

"By the study of the right inguinal glands after subcutaneous inoculation in the right thigh, we find that the hematozoa are present from 1 to 3 days before they are discoverable in the blood (taken from the ear or right leg). Again, they may be very abundant in the gland when they are still scanty in the blood. Moreover, the number in the blood may increase, while that in the gland decreases. In these earlier stages the hematozoa may be extremely numerous, forming tangles and clusters in the lymph gland, while only a few scattered ones are to be found in the blood. The first appearance of hematozoa in the gland of the other side is apparently associated with their appearance in the blood.

"The observations, fewer in number, which have been made upon guinea pigs, also point to a multiplication in or about the nearest chain of lymphatic glands in the first instance.

"We have not yet determined whether these hematozoa pass directly into the blood through the local blood vessels or whether they are distributed by means of lymphatic paths into the main circulation.

"The animals may appear comparatively well while large numbers of parasites are present in their blood and glands; this is especially the case with rats and guinea pigs. On the other hand they may be seriously ill while the hematozoa are scanty in their blood; this obtains usually in rabbits, in which animals, as already stated, the glands do not become so much enlarged, and it is possible that the main effect of the parasites is borne by other organs. For instance, at times the bone marrow has shown the presence of hematozoa, although search in other organs and in the blood proved negative.

"After death in the various animals hematozoa are to be found in most cases in the bone marrow and spleen. The adult hematozoa may be common in these situations when but few are present in the blood; but this is not constant, for the reverse may be the case. Multiplication of the parasites certainly takes place in the lymphatic glands (rat) as well as in the infected area of connective tissue. It may also occur in the above-mentioned organs as well, and perhaps, too, in the blood, but of this we have no certain evidence.

"The hematozoa are also found in the fluids of the serous cavities, at any rate when they are present also in the blood.

"They have not been found in the intestinal contents, nor have they been seen in the urine, except in one case in which hematuria and submucous petechiæ of the bladder were present (rat).

"It is evident from these observations that, in order to investigate the development of the hematozoa in the rat, etc., special attention must be paid to the seat of inoculation and the nearest lymphatic glands.

"Dead and nonmotile forms may frequently be found in the circulation and in the lymphatic glands when the disease is advanced. These are less defined and are ghost-like, being somewhat swollen in appearance; they are also generally in an extended condition.

VII. Toxic power of the blood.

"The fact that animals may appear to be well for days while hematozoa are abundant in their blood suggests that the hematozoa do not secrete much, if any, specific toxin, and indeed so far no direct evidence has been obtained of a potent poison manufactured by the hematozoa, either by secretion or by chemical changes induced in the blood.

"Fresh serum after filtration through Berkefeld filters, and blood or serum which had been kept for days in a sterile condition till the hematozoa had died, have had

no specific toxic effects, even when large quantities have been injected into dogs, rats, or rabbits. Blood in which the hematozoa have been killed by exposure to 50° C. has had no more effect. The extracts of organs obtained from diseased animals have also shown no poisonous properties.

"The whole available blood of highly diseased rabbits has been injected immediately after removal into healthy rabbits without producing immediate symptoms of acute intoxication.

"The bile of diseased animals does not appear to be more toxic than that of healthy animals.

"A cat, into the peritoneal cavity of which a collodion sac full of fresh infected blood had been inserted, showed no signs of illness. It was fully susceptible on subsequent inoculation.

"Dogs, when injected with large quantities of filtered serum from an infected dog, showed no symptoms of a profound toxemia.

"Our experiments do not point to the presence of any intense specific toxin or poison in the blood.

VIII. Immunization and cure.

"The endeavors to produce immunity, or to cure the disease after its establishment, are shortly summed up as follows:

"1. Animals which have been repeatedly injected with blood or serum of nagana animals, such blood or serum having been previously freed from living hematozoa, either by filtration, heat, or by allowing it to stand for a week or longer, have not shown the slightest degree of an acquired immunity. Rats, rabbits, and dogs have been tested in this manner, but none of these animals have shown any diminution in susceptibility.

"2. Animals repeatedly injected with extracts of the organs of diseased animals have acquired no resistance.

"3. The blood of almost full-term fetuses, prematurely born of highly diseased rabbits, has been tried, but without the slightest success in prevention or cure.

"4. The guinea pig being a comparatively resistant animal, its serum has been used, but it also has no immunizing action.

"5. Repeated inoculations of bile of diseased animals have been without preventive or curative effects, although *in vitro* bile, which is always free from hematozoa, rapidly destroys the hematozoa. Infective blood mixed with sufficient bile becomes noninfective, but confers no immunity.

"6. Previous inoculations with the hematozoon of the ordinary rat (*T. sanguinis* [*T. Lewisi*]) have also been valueless.

"7. Sewer rats and white rats which have been repeatedly, but unsuccessfully, inoculated with the ordinary rat hematozoon (*T. sanguinis* [*T. Lewisi*]), and have been proved to be refractory to further inoculations with this hematozoon, have all contracted nagana when subsequently inoculated, and have died in the same time as control animals treated with an equal dose of infective blood.

"8. The young born of infected mothers (dog, guinea pigs) are no more resistant than those born of normal animals.

"9. As already stated, by constant transmission through different species, the nagana hematozoon has shown no definite loss or gain in the intensity of virulence.

"10. Of immunizing sera the diphtheria antitoxin and antistreptococcus serum have been used, but, as we expected, without the slightest effect; they neither protect nor cure.

"11. *Dieting.*—Rats have been fed, on the one hand, exclusively with meat, and, on the other, with green vegetables; in neither case has any increased resistance or prolongation of life resulted from this alteration in diet.

"12. Excision of the lymphatic glands immediately after inoculation or after they have begun to show enlargement has been of no avail.

"13. Feeding with hematozoa also conveys no immunity.

IX. Allied hematozoa.

[See also pp. 33–43.]

1. Trypanosoma sanguinis [*T. Lewisi*].

[See also p. 33.]

"As already mentioned, in sewer rats (*Mus decumanus*) a *Trypanosoma* may be found in a certain percentage of individuals. This hematozoon is distinct from that of nagana morphologically, and also as regards its pathogenic effects. Thus (1) the *T. sanguinis* [*T. Lewisi*] has not been communicated to the dog, cat, rabbit, or mouse, even when large quantities of blood were used for inoculation. (2) In some guinea pigs it has been found in very small numbers in the blood for two or three consecutive days, usually from about the fifth day after injection; but there has been no persistence. (3) In white rats many unsuccessful inoculations have been made with the *T. sanguinis* [*T. Lewisi*], even with considerable doses, and it appears that the minimal infective dose is larger than with the nagana *Trypanosoma*. (4) White rats may lose the hematazoon after they have been proved to have been successfully inoculated with the *T. sanguinis* [*T. Lewisi*]. (5) Some of those which had had, and then lost, the parasite proved refractory on reinoculation. Black and white (piebald) rats have never been successfully inoculated in our experience. (6) No rat has been successfully inoculated with the *T. sanguinis* [*T. Lewisi*], except at the first attempt. (7) We have not been able to recognize any illness after successful inoculations with *T. sanguinis* [*T. Lewisi*]. Any pathogenic effect it may have must be slight. Infected rats remained alive for months; we have not observed any instance where death was to be ascribed to the hematozoon.

"R. Koch[a] examined rats in Dar-es-salam, and also recognized differences between the hematozoon of the local rats and the *Trypanosoma* of the tsetse disease. Whether the *Trypanosoma* occurring in the African rats examined by him is identical with that occurring in our English rats we can not decide, although from the brief description given by Koch they certainly closely resemble each other. Nor did Koch succeed in infecting animals other than rats with the African rat *Trypanosoma*. He therefore showed that the parasites which occur in the blood of rats (in Dar-es-salam) do not stand in any relation whatever to the tsetse disease of horses and cattle. In this connection the observations of Bruce are of great value, because they prove that in big game the tsetse parasite certainly does occur without apparently causing acute, fatal, or even obvious disease; in the same manner, this parasite may sojourn in the body of the guinea pig for weeks and months without interfering with the health and development of the animal for a long time. Furthermore, Bruce (in an unpublished report) has made similar observations on the South African goat and sheep; he shows that in these animals the disease runs an extremely protracted course, and lasts for months.

2. Trypanosoma of surra (*Trypanosoma Evansi*).

[See also p. 35.]

"Koch announces that the disease known as surra in India and the tsetse disease of Africa are produced by the same parasite. His reasons for this assumption are apparently not based on extensive personal comparative observation.[b] Lingard, working in areas naturally infected with surra, has not clearly distinguished between the Trypanosoma of surra and that occurring in rats in India. His account of surra as it occurs in rabbits and guinea pigs and rats is suggestive of this disease being closely

[a] Reiseberichte, 1898a, pp. 70 and 71. [b] Reiseberichte [1898a], p. 66.

similar to nagana, but it is impossible for us to pretend to give any final decision in the matter. To illustrate the confusion in which Lingard has placed the matter, it may be pointed out that he writes that cows, horses, monkeys, and field rats are susceptible to inoculation with the ordinary Indian rat hematozoon, but that rabbits, guinea pigs, dogs, cats, and donkeys are insusceptible, but he adds that the latter animals are susceptible after this rat hematozoon has been passed through the horse. He also asserts that surra can be produced in horses by feeding on the excrement of rats. These observations are calculated to create a certain amount of suspicion, particularly when it is remembered that Vandyke Carter failed to infect horses with the Indian rat *Trypanosoma*.[a] For the present, therefore, the question must be left open till an opportunity arises of studying the various parasites at the same time side by side, both in their morphology and pathogeny.

3. Trypanosoma of Rouget.[b]

[See also p. 37.]

"Rouget describes *Trypanosoma* disease in Algeria, which apparently is identical with the disease described by Bruce. Judging from the drawings and descriptions, his parasite agrees with that of nagana. He will not commit himself as to the identity of his parasite with that of surra. White rats and mice, rabbits, and dogs exhibited a considerable susceptibility, while guinea pigs, he says, were refractory (possibly because he did not recognize the chronicity of the disease). Sewer rats were not always susceptible, while some showed a relative immunity. It seems, however, that he did not reinoculate them so as to test their immunity again. His description of the symptoms and anatomical appearances in mice, rats, rabbits, and dogs agrees almost exactly with our own observations. He claims to have succeeded in immunizing a number of mice by injecting them with the serum of an infected rabbit previous to inoculating the *Trypanosoma;* six mice survived altogether,[c] while others lived for 17 to 23 days. As a curative agent this serum was useless. Guinea pigs' serum also had no preventive action.

X. Biology of the nagana hematozoon.

"So far our knowledge of the nagana parasite, as that of other Trypanosomas, is very incomplete. Rouget[d] has failed to find forms corresponding to those described by Danilevsky in birds and by Shalashnikov in rats, and Lewis and others have been equally unsuccessful, while it is difficult to follow Lingard in his description of young forms. We have not succeeded in tracing a life history, and we are still in search of developmental forms, a task which at present occupies our special attention.

"1. Most commonly in blood, etc., drawn from infected animals the forms described by Bruce are found. They are generally in active movement and can sometimes be observed in locomotion with their flagellated end forwards, as Lewis described in the case of other hematozoa; in many cases they do not change their position by free swimming, but tend to fix themselves by one or other end to the coverslip or to corpuscles or cells in the specimen. They then exhibit more or less rapid oscillations, and may change their position by apparently drawing or pushing themselves in one direction or the other. Meanwhile the vibratile membrane waves rapidly and the protoplasmic body alters in shape, becoming thicker and shorter or thinner and longer. In the case of the English rat hematozoon free swimming is the rule. Changes in the shape of the body like those of the nagana organism are not observed.

"2. The nagana parasites vary considerably both in size and form; they may be long and pointed or blunt-ended and somewhat stouter. Some individuals are short

[a] Scientific Memoirs of Med. Officers of the Army of India, 1887, Part III, p. 56.

[b] Annales de l'Institut Pasteur, 1896, vol. 10, p. 716.

[c] It does not appear whether they were again tested.

[d] Loc. cit. [1896], pp. 722 and 723.

and thick with a short flagellum, their protoplasm being crowded with rounded granules. Still larger forms possessing more than one vibratile membrane are sometimes, though rarely, met with.

"3. Especially in specimens taken from lymphatic glands, but also in specimens obtained from the blood, etc., there is a clear vacuole at the thick end. This does not become stained with staining reagents. It varies much in size in the different individuals, but we have watched in vain for evidence that it is of a contractile nature.

"4. By means of hemalum or hematoxylin a nuclear body can be demonstrated in the middle of the parasite. It is usually oval, but may be more saddle-shaped. The protoplasm also contains a number of granules which stain with basophil reaction (methylene-blue, thionin, etc.); these are somewhat variable in number, being fewer in specimens in which the protoplasm is more refractive, e. g., from lymphatic gland. These granules are distributed irregularly throughout the body of the parasite; they do not occur in the membrane or the flagellum. The chromatin spot situated close to the nonflagellated end in the *T. sanguinis* [*T. Lewisi*] is not defined in the nagana *Trypanosoma*. The *T. sanguinis* [*T. Lewisi*] also does not stain at all readily even by basic aniline dyes (dahlia, fuchsin, etc.) while that of tsetse disease is more readily colored by these reagents.

"5. Examples joined by the poles opposite the flagellum are common at times, but although they suggest perhaps conjugation, we have no evidence that this process does really occur. After prolonged observation no further changes have been noticed in these jointed individuals.

"In freshly drawn blood, or in the lymph of lymphatic glands, or in pleural and peritoneal fluid, when the hematozoa are common, tangles made up of numerous hematozoa have been observed; this has been already described by Lewis. The hematozoa often converge with their nonflagellated ends toward one common point. In lymphatic glands, before the hematozoa are found in the blood, such tangles may be present in great numbers.

"6. Forms consisting apparently of two individuals joined side by side by their bodies, the flagella being free, have been observed on rare occasions; from prolonged observation in the living state we have no reason to suppose that these are undergoing longitudinal fission. Especially in kept blood, etc., many of the hematozoa may present a rhomboid outline while still motile.

"In drawn blood or serous fluids the hematozoa eventually become motionless; this may occur rapidly, for instance in 20 minutes, but generally some motile specimens can be found after 2 to 3 days—sometimes, indeed, after as long as 5 or 6. When they are abundant, the tangles above noted are formed. Then the bodies of the organisms become rounded, the nuclear bodies becoming more distinct and readily stainable (hematoxylin or basic aniline dyes). At the same time the vibratile membrane or fin and the flagellum separate, forming a rather rigid filament. Eventually (generally after 3 to 4 days) masses of spherules alone remain; these apparently correspond to the nuclear bodies. In numerous experiments these structures have uniformly proved to be noninfective, and it must therefore be inferred that if they are not simply degeneration products, they require other conditions for their further development than those that are found in warm-blooded animals. All individuals, however, do not pass through these changes; some, or even all, may simply become nonmotile, stiff, and pale, at the same time retaining their form. In numerous attempts at cultivation in normal blood, similar phenomena are observed without any evidence of multiplication. Within a corpse the blood and organs become noninfective in about 24 hours, the changes in the hematozoa being similar to those just described.

"Exposure for several hours in an atmosphere of hydrogen or CO_2 has no appreciable effect on the motility of hematozoa in blood-free serous fluids. The hematozoa are also fully active in hosts killed by ether, chloroform, or coal gas.

"7. Oval forms, smaller than the ordinary hematozoa, with (or without) a short flagellum, and often with a 'beak' at the opposite pole, have been observed in the organs, but rarely in circulating blood.

"8. Small rounded or ovoid bodies, about 1 to 2 μ in diameter, hyaline, sometimes with a refringent chromatin spot or bipolar spots, or irregular (? amoeba-like) bodies, also sometimes with a chromatin spot and of the same size or rather larger, have been observed, especially in the lymphatic glands and bone marrow, or spleen. It is possible that these are early stages in the development of the hematozoon. No forms have been seen at any time within the red-blood corpuscles.

"9. Neither sporocystic nor larger distinctly amoeboid forms have been observed.

"As our observations on the development of the parasites are still in an incomplete condition, this short statement must suffice, and a more detailed description must be left for a future occasion, when we submit a full report upon our work."

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MAL DE CADERAS.

In South America there exists an equine disease which is more or less closely related to surra and dourine. Lecler (1899, p. 6) was inclined to consider it of bacterial origin, but Elmassian (1901a, p. 604) and Voges (1901a, p. 598) consider it due to a *Trypanosoma*, for which Voges proposed the name *Trypanosoma equinum*. The parasites are most numerous in the circulation during the rise of temperature. Upon its reaching 40° to 41° C., they gradually disappear, but reappear upon the next increase in temperature. In length the trypanosomes are three to four times the diameter of a red-blood corpuscle.

This malady extends from the Argentine provinces St. Fe and Corrientes on the south to Chaco, Missiones, Paraguay, Matto Grosso, and Bolivia on the north. It is a "wet weather" disease, which almost completely disappears in dry seasons. Horses, mules, asses, swine, and water hogs are said to be affected, and horses are never known to recover. It is chronic in course, lasting 2 to 5 months in horses and 6 to 12 months in asses and mules. The clinical symptoms are described as an intermittent fever, the temperature usually rising slowly, then suddenly falling to normal; rapid progressive emaciation; dark-red urine occasionally containing albumen and blood; the red-blood corpuscles decrease in number, and the microscopic changes of pernicious anemia appear; the lymphocytes and especially the eosinophiles increase considerably in number; the most marked symptom is a symmetrical or an asymmetrical paresis of the hind legs; defecation and urination (coinciding with paralysis of the sphincter ani and of the bladder) difficult; dyspnea; appetite and extreme thirst preserved to the last; gradual extension of the paralysis to other parts of the body; edema frequent. On postmortem there are noticed enlargement of the spleen and of the lymphatic glands; serofibrinous exudations in the body cavities; liver enlarged and engorged with blood; heart flabby; lungs, often with hemorrhagic herds, and subpleural emphysematous patches; catarrhal condition of the respiratory passages, and pathologic changes in the spinal cord.

The blood is infectious upon inoculation, but not upon ingestion; white and gray rats and mice, rabbits, guinea pigs (rarely), dogs, goats, sheep, chickens, turkeys, ducks, monkeys (*Nyctipithecus felinus*), and other animals are said to contract the disease upon inoculation.

Treatment with quinine, methylene blue, arsenic, enterol, permanganate of potassium, and other drugs has been without success.

[Since the above was sent to press, an extensive and valuable article on mal de caderas has been published by Voges (1902, pp. 323–372, pl. 5, figs. 1–7), to which the reader is referred for further details.]

TRYPANOSOMIASIS IN RATS AND BANDICOOTS.

RAT.

Considerable confusion has resulted in literature because of the misinterpretation of trypanosomiasis in rats. Thus the parasite of horse surra in India has been confused with the common trypanosome of Parisian and London rats. From present data it appears that rats (*Mus decumanus* and others) may harbor at least five species of *Trypanosoma*, namely: (1) *Trypanosoma Lewisi*, the form usually known as the rat trypanosome, and usually looked upon as a comparatively harmless organism. It is apparently quite common in rats in wet weather, while four other species—namely, (2) *Trypanosoma equiperdum*, the supposed cause of dourine; (3) *Trypanosoma Brucii*, the cause of tsetse-fly disease; (4) *Trypanosoma Evansi*, the cause of surra; and (5) *Trypanosoma equinum*, the cause of mal de caderas—are all transmissible to rats.

It is quite apparent from Lingard's accounts that he did not always distinguish between *Trypanosoma Lewisi* and *T. Evansi*, and this fact explains a number of apparently contradictory results in his experiments.

Thus, Lingard (1894a, pp. 4–5) says:

EXPERIMENTS ON ANIMALS WITH THE HEMATOZOON OF THE RAT.

"Proof was wanting that this hematozoon was capable of producing surra, when blood containing the organism was subcutaneously injected into horses and some other species of animals. As early as November, 1890, I commenced a series of experiments for the purpose of deciding the above question and obtained positive results, but found that the periods of incubation were more prolonged than in horse surra, in one case being as much as 63 days. Notwithstanding this, the virulence of the disease when once developed was intense, as shown by the short period during which the animal survived after the appearance of the hematozoon in the blood, this being in three cases only 2 to 5 days.

INOCULATION WITH THE SOILED BLOOD OF THE RAT (*Mus decumanus*).

"Of 12 horses inoculated with soiled rat's blood, 4 animals contracted surra, or 33.3 per cent:

(1) Period of incubation lasted 18 days; animal lived 19 days.
(2) Period of incubation lasted 29 days; animal lived 2 days.
(3) Period of incubation lasted 13 days; animal lived 2 days.
(4) Period of incubation lasted 63 days; animal lived 5 days.

"Although the latent period of rat surra was so prolonged in the first instance, when inoculated from rat to horse (average 40.7 days), it immediately returned to the normal period (average 7 to 8 days), when a second horse was inoculated with the blood of the first affected. The latent period, however, becomes still more reduced (5 days) when a third animal is inoculated with the blood of the second.

"2. Horses unsuccessfully inoculated and reinoculated subcutaneously with the rat hematozoon, when subsequently inoculated with horse surra blood show no protection from the former, but acquire the disease after an incubation period of 6 to 10 days.

"3. Animals other than horses which contracted the disease were bovines, monkeys, and field rats, while the rabbit, guinea pig, fowl, cat, dog, and donkey proved refractory to the rat hematozoon. But all the above animals with the exception of the fowl were very susceptible to the rat hematozoon when it had first been passed through the horse.

EXPERIMENTS ON THE GASTRIC INGESTION OF RATS' EXCREMENT.

"The above experiments raised the question as to how rats could cause the disease in horses; for the food would rarely if ever be soiled with the blood of these animals. It therefore only remained to be tried whether the excreta of rats, in whose blood the infusorian was present at the time of its collection, could cause the disease when mixed with grain.

"2. In 1892 experiments were undertaken at Poona, on the Deccan plateau, where the disease is not enzootic, and where the difficulty of producing it was fully recognized, owing to the dryness of the situation at that period of the year (December to February). These experiments, as expected, proved negative.

"3. At a later date, during the latter half of the hot season and the rains of 1893, further experiments with the same end in view were carried out in Bombay, where the climate is favorable from its humidity and the disease is enzootic. From these positive results were obtained, the incubation period occupying 4 months (about June to September); but the incubation period of the disease will probably be found to vary with the amount of moisture present in the atmosphere and amount of *materies morbi* ingested by the animal. This points to the probability of a number of the surra cases in Bombay being contracted through the ingestion of rats' or bandicoots' excreta mixed with the corn. Although not yet definitely proved, it is more than likely that the excreta of young and half-grown bandicoots have the same power of producing the disease, as the hematozoon is also frequently present in their circulation."

It seems to us that the above statements indicate very clearly that at least two species of *Trypanosoma* were present.

Despite this confusion, Lingard (1895, p. 10) presents some exceedingly interesting facts regarding trypanosomiasis in rats. Thus, from November, 1890, to May, 1895, the blood of 3,105 rats (*Mus decumanus*) was examined microscopically, and 1,084, or 34.91 per cent, were found to contain *Trypanosoma*, while in 2,021 cases, or 65.09 per cent, the examination was negative.

In an earlier paper Lingard (1894, pp. 3–4) brings out the following points, which are of interest in the way of comparison:

"Dividing the (Bombay) year into two periods—

(1) Dry and hot (January to May, inclusive),

(2) Rainy and humid (June to December, inclusive),

we find that during the period November [1890] to July, 1894, 421 out of a total of 1,107 rats examined contained the hematozoon in their circulation. It was present

in 31.53 per cent of the rats caught from January to May, and 40.31 per cent of those obtained from June to December, or during the rainy season. Although in the hot season the hematazoon is present in the circulation of these animals, the organisms are very few in number, while during the latter period of the year they are far more numerous, the percentage of cases in which the hematozoa are very numerous or swarming being 24 in the dry season and 52.61 in the rainy season, or in a ratio of 1 : 2.19.

"3. There is a tendency in the hematozoon to disappear from the circulation of some rats when kept in captivity and supplied with clean food and water.

"4. About 60 per cent of young rats from 2 to 4 months old have the hematozoon present in their circulation, and usually in large numbers.

"5. The blood of rats obtained from certain localities was almost always free from the hematozoon, while that of the majority of rats from other localities was affected.

"6. The hematozoon of the rat appears to disappear from the circulation at irregular intervals, thus producing paroxysms and intermissions, as in the case of surra in the horse.

"7. The presence in varying numbers of the hematozoon in the circulation of rats does not appear to produce any noticeable symptoms in the great majority of them. But some few rats whose blood swarmed with the hematozoon have succumbed to leucocytosis, with extravasations of blood containing the organism into the anterior chamber and vitreous humors of the eye, opacity of the cornea, enlarged spleens, and extravasations of blood, or in some cases ulceration of the mucous membrane of the stomach.

"8. It has been observed in a considerable number of cases that although the hematozoon may be present in vast numbers in the blood of pregnant rats (*Mus decumanus*), in no case has the hematozoon been discovered in the circulation of the fetus.

"9. *Parasites, stomach.*—Nematode worms varying in number and dimensions were found in the stomach of rats in which the hematozoon was either present or absent. In a total of 203 examined, nematodes were found in 40, or 19.75 per cent.

"10. *Saliva.*—Microscopical examination of saliva proved the absence of the *Trypanosoma* when the hematozoon was swarming in the blood at the same time. Immediately, however, a slight wound of the mucous membrane of the mouth was made, the organisms were discovered in varying numbers, according to the amount of blood mixed with the saliva.

"11. *Urine.*—The hematozoon was always absent from the urine of rats, although swarming in the circulation at the time of examination.

"12. *Bandicoots* (*Mus* (*Nesokia*) *giganteus*).—Previous observers have denied the presence of the hematozoon in the bandicoot, but as early as 1892 I demonstrated the presence of the organism in the blood of young and half-grown animals of this species, whether caught in Bombay and its surroundings or on the Deccan plateau, but it has been absent from all full-grown animals examined.

"13. *Muskrats* (*Sorex cærulescens*) *and mice* (*Mus* species).—The hematozoon has not been found in the blood of these animals."

In his summary of 1895 Lingard (1895, pp. 11–13) adds the following interesting statement:

"3. It will be seen in column No. 8 that the percentage of rats in which the organisms were present in the circulation was highest during those months which included the monsoon season, namely, June to October, inclusive; and during the remaining months the percentage gradually decreased until April was reached. The difference between the maximum, 46.70, and the minimum, 23.47, percentages in July and April, respectively, is 23.23, or nearly half (50 per cent).

Table showing the ratio of spleen weight to body weight when the hematozoon is present or absent from the circulation of rats (Mus decumanus), *male and female, whose body weights are over or under 60 grams.*

Hematozoon present or absent in the blood.	Number of rats.	Males under 60 grams, ratio S. to B. W.	Number of rats.	Females under 60 grams, ratio S. to B. W.	Number of rats.	Males over 60 grams, S. to B. W.
Absent	186	1:228.4	171	1:232.2	455	1:205.5
Few	49	1:139.8	48	1:201.5	104	1:190.0
Numerous	44	1:136.6	32	1:166.8	37	1:154.3
Very numerous	47		28		22	
Swarming	78	1:107.2	55	1:119.2	23	1:137.9
Total	404		334		641	
Present	218	1:125.7	163	1:157.4	186	1:169.1
Absent	186	1:228.4	171	1:232.2	455	1:205.5
Total	404		334		641	

Hematozoon present or absent in the blood.	Number of rats.	Females over 60 grams, ratio S. to B. W.	Number of rats.	Males and females under 60 grams, ratio S. to B. W.	Number of rats.	Males and females over 60 grams, ratio S. to B. W.
Absent	578	1:203.3	357	1:230.3	1,033	1:204.3
Few	95	1:144.3	97	1:166.7	199	1:165.7
Numerous	29	1:137.4	76	1:147.4	66	1:146.9
Very numerous	23		76		45	
Swarming	22	1:087.5	133	1:112.0	45	1:108.1
Total	747		738		1,388	
Present	169	1:131.2	381	1:139.3	355	1:149.9
Absent	578	1:203.3	357	1:230.3	1,033	1:204.3
Total	747		738		1,388	

"5. It will be seen from the above table that the weight of the spleen increased (from a minimum in the absent cases) in regular gradation according to the number of hematozoa present in the circulation of the rats.

"6. *Pregnant.*—Of 2,154 rats examined 1,070 were males and 1,084 females. Seventy-seven females were pregnant, the hematozoon being present in the blood of 19 and absent from it in 58; or a percentage of 32.75, as against 67.25. In no instance has the *Trypanosoma* been discovered in the circulation of the fetus, although at the same time it was present in varying numbers in the blood of the mother.

"7. *Parasites* (stomach).—Nematode worms, varying in number and dimensions, were found in the stomachs of rats (in some instances the above organ was fully distended by the number of parasites), in which the hematozoon was either present or absent.

"In 2,154 examined during the year, nematodes were found in 23.58 per cent. But it is of interest to note that during the rainy season—June to November—the percentage was 16.27, whilst during the months December to May it rose to 29.36 per cent. The percentage varied during the twelve months from 7.25 in July to 37.50 in April.

"8. The great majority of rats present the hematozoon in their circulation sometime during the rainy season. From our observations the spleen attains its maximum size toward the end of the rains, and from that period the size of the organ gradually diminishes during the dry and hot season, until the advent of the following monsoon, unless occasional heavy rains fall between November and May.

"9. It has been observed during the middle of the hot and dry season that when rain suddenly falls after a long period of drought (4 months) the percentage of animals in which the hematozoon is found increases rapidly in the first few days (7) following the fall. The percentage then rapidly falls, and a second maximum is reached during the fourth week.

"The increase of percentage in the first week was found to be 7.5, while the maximum in the fourth week was 11 per cent.

EXPERIMENTS WITH THE HEMATOZOON OF THE RAT (*Mus decumanus*).

"Horses injected subcutaneously on numerous occasions with rat's blood containing swarms of the hematozoa proved refractory to the rat disease, but readily contracted surra in the usual period (5 to 7 days) when a small scratch on the muzzle was smeared with a trace of soiled guinea pig blood.

BANDICOOT.

EXPERIMENTAL INVESTIGATIONS RE HEMATOZOON IN BANDICOOTS.

Showing the bandicoots (Mus (Nesokia) giganteus) *examined from July, 1894, to end of April, 1895, and the relative number of hematozoa in their circulation.*

Hematozoa in blood.	In field of microscope.	Number of bandicoots.	Percentage.
Absent		112	74.66
Few	1 to 5	7	4.66
Numerous	5 to 20	8	5.33
Very numerous	20 to 50	12	8.00
Swarming	Over 50	11	7.33
Total		150	100.00
Absent		112	74.66
Present		38	25.33

"The experiments made during the past year confirm our last year's observations as to the presence of the *Trypanosoma* in the circulation of young and half-grown animals of this species and their almost entire absence from full-grown animals examined. This exception occurs during the wet season.

"2. Several varieties of the *Trypanosoma* have been found in the blood of bandicoots but they appear to belong to the same species.

"3. The difficulty experienced in obtaining bandicoots on the Deccan plateau militated against the attempt on our part to obtain a complete knowledge of the conditions of the blood of these animals during each month of the year. But it is more than probable from our present knowledge that the same changes with regard to the *Trypanosoma* during the dry and wet seasons occur in the circulation of bandicoots as those detailed as observed in the rat.

"4. Nematode worms, varying in numbers and dimensions (one-half to 5 inches in length) were found in the stomachs of bandicoots, in many instances completely distending the organs. In a total of 150 animals examined, nematodes were found in 90, or 60 per cent.

"5. The livers of these animals were also the seat of extensive changes caused by the presence of vast numbers of nematode eggs, some of which mature 'in situ,' and frequently the young worms escape into the peritoneal cavity.

"6. The chief pathological changes observed were ulceration (sometimes extensive) of the villous portion of the stomach, and, as an effect of the former, the

formation of diverticula, the walls of the sac being formed of thickened peritoneum extravasations of blood under the submucous tissues, enlarged spleen (4 or 5 times normal), and less frequently abscess of liver, spleen, and subcutaneous tissues.

"7. As in the case of pregnant rats, so in that of pregnant bandicoots; although the *Trypanosoma* was present in vast numbers in the blood of the mother, in no instance has it been discovered in the circulation of the fetus.

"8. The blood of the majority of bandicoots during the rainy season was found to contain an exceedingly minute spirillum, even when the *Trypanosoma* was absent from their circulation. Rabbits and guinea pigs inoculated subcutaneously with blood containing this organism contracted the disease, and death resulted in the majority of instances.

INOCULATION OF ANIMALS WITH BANDICOOTS' BLOOD.

"1. The donkey proved refractory to the *Trypanosoma* of the bandicoot, although blood teeming with the organism was on numerous occasions subcutaneously injected.

"2. Except in one instance, when the hematozoon appeared on the fourth day after inoculation, and death occurred on the forty-first day, guinea pigs generally proved refractory to the soiled blood of the bandicoot. The same applies to rabbits.

"3. Rabbits and guinea pigs acquired no resistance even to the least virulent type of surra, when subcutaneously injected daily for varying periods, with large quantities of full-grown bandicoots' blood, *sine* hematozoon."

BIBLIOGRAPHY OF SURRA AND ALLIED TRYPANOSOMATIC DISEASES.

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The following bibliography is taken from the card catalogue of the Zoological Laboratory of this Bureau, and probably contains most of the titles bearing directly upon the subject under discussion.

For the benefit of Government officials, I have indicated the Governmental libraries where the works in question may be consulted, as follows:

W^a. Library of the United States Department of Agriculture.
W^c. Library of Congress.
W^m. Library of the Surgeon-General's Office.
W^s. Library of the Smithsonian Institution.

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[Identifies parasite of surra with that of rat; *Mus decumanus* and *M. rattus* (?) found infected; *M. bandicottus* and *Sorex* sp. not infected; in pregnant females, fetus not infected; increase of leucocytes; experiments with rat, dog, cat, monkey, horse, rabbit; general discussion.]

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[Excellent article; geographical distribution; definition; symptoms; postmortem appearances; mortality; contagion and infection; believes flies may carry the disease; different animals affected—horse, mule, camel; remote causes; prevention; cure; no confidence in carbolic acid; the parasite; history of individual cases, with accounts of treatment and tables of pulse, temperature, and urine.]

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1891.—The etiology of surra. [Criticism of Ranking, 1891a] <Vet. J., Lond., v. 33, Oct., pp. 309–310. [W^{a}.]

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1902.—Bibliography of surra and allied trypanosomatic diseases. Bull. No. 42, Bureau Animal Indust., U. S. Dept. Agric., Wash., pp. 131–148. [W^{a}.]

HAYES, M. H.

1898.—Surra. (*In* Friedberger and Fröhner's Veterinary Pathology. Infective Diseases of Animals. Translated and edited by M. H. Hayes, with notes on Bacteriology by G. Neumann. 8°. London.) [W^{a}.]

[Pp. 477–487, chapter on surra, written by Hayes and based largely on Lingard.]

HÉROUARD, EDGARD. *See* Delages, Yoes, & Hérouard, Edgard.

JOLYET, F., & DE NABIAS, B.

1891.—Sur un hématozoaire du lapin domestique <J. de méd. de Bordeaux, v. 20 (31), 1 mars, pp. 325–326. [W^{m}.]

KANTHACK, A. A., DURHAM, H. E., & BLANDFORD, W. F. H.

1898a.—On nagana or tsetse fly disease. (Report made to the tsetse fly committee of the Royal society of observations and experiments carried out from November, 1896, to August, 1898) <Proc. Roy. Soc. Lond. (Nov., 1898–Mar., 1899), v. 64 (404), Nov. 19, pp. 100–118. [W[m].]

1898b.—Nagana or tsetse fly disease. [Review of Kanthack, Durham, & Blandford, 1898a] <Brit. M. J., Lond. (1980), Dec. 10, pp. 1768–1769. [W[s].]

1898c.—Ueber Nagana oder die Tse-tse Fliegenkrankheit. [Transl. of Kanthack, Durham, & Blandford, 1898a, by G. H. F. Nuttall] <Hyg. Rundschau, Berl., v. 8 (24), 15. Dec., pp. 1185–1202, 1 fig. [W[s], W[m].]

1898d.—Idem [abstracted] <J. Comp. Path. & Therap., Edinb. & Lond., v. 11 (4), Dec. 31, pp. 370–380. [W[m].]

1899a.—Tsetse disease in mammals <Proc. Fourth Internat. Cong. Zool., Cambridge (22–27 Aug., 1898), Lond., pp. 166–168. [Lib. Stiles.]

[Practically the same as Durham, 1898, pp. 535–538.]

1899b.—On nagana or tsetse fly disease <Veterinarian, Lond., v. 72 (853), Jan., pp. 1–11; (854), Feb., pp. 68–79. [W[s].]

[Same as Kanthack, Durham, & Blandford, 1898a.]

KEMPNER, WALTER. *See* Rabinowitsch, Lydia, & Kempner, Walter.

KENT, W. SAVILLE.

1880.—A manual of the Infusoria, including a description of all known flagellate, ciliate, and tentaculiferous Protozoa, British and foreign, and an account of the organization and affinities of the sponges. Pts. 1–3, pp. 1–432, pls. 1–24. 8°. London. [W[m].]

[*Trypanosoma*, pp. 218–220.]

KINYOUN, J. J. *See* Smith, Allen M., & Kinyoun, J. J.

KOCH, ROBERT.

1881.—Zur Untersuchung von pathogenen Organismen <Mitth. a. d. k. Gsndhtsamte, Berl., v. 1, pp. 1–42, pls. 1–14. [W[s].]

1898a.—"Reise-Berichte über Rinderpest, Bubonenpest in Indien und Afrika, Tsetse- oder Surrakrankheit, Texas-Fieber, tropische Malaria, Schwarzwasserfieber." 136 pp., 10 figs. 8°. Berlin. [W[m].]

1898b.—Report on the surra disease <Brit. M. J., Lond., v. 1 (1945), Apr. 9, p. 983. [W[s].]

[Brief reference to Koch's report from Dar-es-Salam; mules and ordinary donkeys subject to surra, but masai donkeys are apparently immune.]

KRUSE, W.

1896.—Systematik der Protozoen. (*In Flügge's* Die Mikroorganismen. Mit besonderer Berücksichtigung der Ätiologie der Infektionskrankheiten. 3. ed., pt. 2, pp. 601–700, figs. 128–153.) [W[m].]

[*Trichomonas columbarum*, *T. intestinalis*, *T. vaginalis*, pp. 629–632.]

KÜNSTLER, G.

1883.—Recherches sur les Infusoires parasites. Sur quinze Protozoaires nouveaux <Compt. rend. Acad. d. sc., Par., v. 97, 2. semestre (14), 1 oct., pp. 755–757. [W[s], W[m].]

LABBÉ, ALPHONSE.

1891.—Note sur un nouveau parasite du sang (*Trypanomonas Danilevskyi*) <Bull. Soc. zool. de France, Par., v. 16, oct., pp. 229–231. [W[s].]

LABOULBÈNE, A.

1888.—Sur une mouche tsé-tsé de l'Afrique australe <Bull. Acad. de méd., Par., An. 52, 2. s., v. 19 (22), 4 juin, pp. 721–724. [W[m].]

DE LACERDA, J. B.

1885.—Pathogenesia comparada. Peste de Cadeiras ou epizootia de Marajó suas analogias com o Beriberi. viii + 98 pp. 3 pls., 2 phot. 8°. Rio de Janeiro. [W^{m}.]

DE LANESSAN, J. L.

1882a.—Manuel d'histoire naturelle médicale. Pt. 3, Zoologie, 728 pp., 523 figs. 12°. Paris. [W^{a}.]

[P. 71, fig. 60, brief mention of *Undulina ranarum*.]

1882b.—Traité de zoologie, Protozoaires. vii + 336 pp., 281 figs. 8°. Paris. [W^{a}.]

[Pp. 166–167, fig. 142, brief reference to "*Trypanosoma sanguinis* Gruby" and *Trypanosoma Eberthi*.]

LANKESTER, E. RAY.

1871.—On *Undulina*, the type of a new group of Infusoria <Quart. J. Micr. Sc., Lond., n. s., v. 11 (44), Oct., pp. 387–389, figs. 1–4. [W^{m}.]

[Living parasites found in frog's blood described as *Undulina ranarum*.]

1882.—On *Drepanidium ranarum*, the cell-parasite of the frog's blood and spleen (Gaule's Würmchen) <Quart. J. Micr. Sc., Lond., n. s., v. 22 (85), Jan., pp. 53–65, figs. 1–5. [W^{m}.]

LAVERAN, ALPHONSE. (*See also* Laveran, Alphonse, & Mesnil, F.)

1892.—Des Trypanosomes parasites du sang <Arch. de méd. expér. et d'anat. path., Par., 1. s., v. 1 (2), 1 mars, pp. 257–269, pl. 1. [W^{a}, W^{m}.]

1893.—Paludism. xii + 197 pp., 7 figs., 6 pls. 8°. London. [W^{a}.]

1895.—Les Hématozoaires de l'homme et des animaux. Pt. 1, Protozoaires du sang, iv + 154 pp., 9 figs. Paris. [Lib. Stiles.]

[Account of *Trypanosoma* in various animals, pp. 129–149.]

LAVERAN, ALPHONSE, & MESNIL, F.

1900a.—De la longue conservation à la glacière des Trypanosomes du rat et de l'agglomération de ces parasites <Compt. rend. Soc. de biol., Par., v. 52 (29), 12 oct., pp. 816–819. [W^{a}.]

[Describes agglutination.]

1900b.—Sur l'agglutination des Trypanosomes du rat par divers sérums <Compt. rend. Soc. de biol., Par., v. 52 (34), 16 nov., pp. 939–942. [W^{a}.]

[Experimented with serum of dog, rabbit, sheep, horse, chicken, pigeon, rat.]

1901a.—Sur le mode de multiplication du Trypanosome du nagana <Compt. rend. Soc. de biol., Par., v. 53 (12), 29 mars, pp. 326–329. [W^{a}.]

[Description and figures of division.]

1901b.—Sur la nature centrosomique du corpuscule chromatique postérieur des Trypanosomes <Compt. rend. Soc. de biol., Par., v. 53 (12), 29 mars, pp. 329–331. [W^{a}.]

[Homologous with the attractive spheres of *Noctiluca* and centrosomes of spermatoids.]

1901c.—Sur la structure du Trypanosome des grenouilles et sur l'extension du genre *Trypanosoma* Gruby <Compt. rend. Soc. de biol., Par., v. 53 (23), 28 juin, pp. 678–680, figs. 1–3. [W^{a}.]

[Genus *Herpetomonas* is discarded.]

1901d.—Sur la morphologie et la systématique des Flagellés à membrane ondulante (genres *Trypanosoma* Gruby et *Trichomonas* Donné) <Compt. rend. Acad. d. sc., Par., v. 133 (3), 15 juillet, pp. 131–137, figs. 1–5. [W^{a}.]

[General discussion; important.]

LAVERAN, ALPHONSE, & MESNIL, F.—Continued.

1901e.—Recherches morphologiques et expérimentales sur le Trypanosome des rats (*Tr. Lewisi* Kent) <Ann. de l'Inst. Pasteur, Par., v. 15 (9), 25 sept., pp. 673–714, pls. 11–12. [W[a].]

[Very important paper.]

1901f.—Sur la nature bactérienne du prétendu Trypanosome des huitres (*Tryp. Balbianii* Certes) <Compt. rend. Soc. de biol., Par., v. 53 (31), 25 oct., pp. 883–885. [W[a].]

[*Trypanosoma Balbianii* does not belong to the genus *Trypanosoma*.]

1901g.—Sur les Flagellés à membrane ondulante des poissons (genres *Trypanosoma* Gruby et *Trypanoplasma* n. gen.) <Compt. rend. Acad. d. sc., Par., v. 133 (18), 28 oct., pp. 670–675. [W[a].]

[Three new species.]

1902a.—Recherches morphologiques et expérimentales sur le Trypanosome du nagana ou maladie de la mouche tsétsé <Ann. de l'Inst. Pasteur, Par., v. 16 (1), 25 jan., pp. 1–55, figs. [W[a].]

1902b.—Study of the *Trypanosoma* of tsetse fly disease. [Abstract of Laveran & Mesnil, 1902a] <J. Am. M. Ass., Chicago, v. 38 (11), Mar. 15, p. 738. [W[a].]

1902c.—Morphological and experimental researches on *Trypanosoma* of rats (*T. Lewisi*). [Review of Laveran & Mesnil, 1901e] <Exp. Sta. Rec., U. S. Dept. Agric., Wash., D. C., v. 13 (6), p. 532. [W[a].]

LECLER, M.

1899.—El mal de caderas (contribucion al estudio de esta enfermedad). 15 pp. 4°. Buenos Aires. [W[a].]

LECLERCQ, EMMA.

1890.—Les microorganismes intermédiaires aux deux règnes <Bull. Soc. belge de Micr., Brux., v. 16 (8), pp. 70–131, figs. 1–7. [W[m].]

LEES, KAY.

1888.—*Glossina morsitans* or tsetse fly <Vet. J. & Ann. Comp. Path., Lond., v. 27, Aug., pp. 79–84. [W[m].]

[Claims to have found the tsetse fly in India, Naga Hills; heavy losses in transport service; quotes Dr. Livingstone's observations on the tsetse fly.]

LEWIS, TIMOTHY RICHARDS.

1878.—The microscopic organisms found in the blood of man and animals, and their relation to disease <14th Ann. Rep. San. Com. India, Calcutta (1877), Appendix B, pp. 157–208, figs. 1–27, pls. 1–3. [W[m].]

1879.—Flagellated organisms in the blood of healthy rats <Quart. J. Micr. Sc., Lond., n. s., v. 19 (73), Jan., pp. 109–114, 1. fig. [W[m].]

1884.—Further observations on flagellated organisms in the blood of animals. <Quart. J. Micr. Sc., Lond., n. s., v. 24 (96), July, pp. 357–369, figs. 1–5. [W[m].]

1888.—Flagellated organisms in the blood of animals. (*In* Physiological and pathological researches; being a reprint of the principal scientific writings of the late Timothy Richards Lewis. Arranged and edited by William Aitken, G. E. Dobson, and A. E. Brown. 8°. London. pp. 604–609.) [W[m].]

LINGARD, ALFRED.

1893.—Report on horse surra. v. 1, 125+ccIxxix pp., 11 pls. fol. Bombay. [W[a].]

[Exceedingly important medical discussion; most extensive paper on surra in print].

LINGARD, ALFRED—Continued.

1894a.—Summary of further report on surra. 8 pp. fol. Bombay. [W^{a}.]

1894b.—Idem <Vet. J., Lond., v. 39 (232), Oct., pp. 250–258; (233), Nov., pp. 311–315. [W^{m}.]

1894c.—The disease surra in solipeds and camels. [Review of Lingard, 1893] <Vet. J., Lond., v. 38, Mar., pp. 172–175. [W^{a}.]

1895.—Summary of further report on surra. 13 pp. fol. Bombay. [W^{a}.]

1896.—Annual report of the imperial bacteriologist for the official year 1895–96. 61 pp., 1 map. 4°. Bombay. [W^{a}.]

1898a.—Annual report of the imperial bacteriologist for the official year 1896–97. iii—77 pp. fol. [Calcutta.] [W^{a}.]

1898b.—Surra report. Appendices, including records of cases, charts, and illustrations. v. 2, pt. 2, 230 pp., 3 pls. fol. Bombay. [W^{a}.]

1899.—Report on surra in equines, bovines, buffaloes, and canines, together with an account of experiments conducted with the *Trypanosoma* of rats, bandicoots, and fish. v. 2, pt. 1, ii—160 pp., pls. 1–2. fol. Bombay. [W^{a}.]

[Very important.]

1900.—Report on surra, disease in horses. [Review of Lingard, 1899] <Vet. J., Lond., n. s., v. 2 (11), o. s., v. 51 (305), Nov., pp. 340–345. [W^{a}.]

1901.—Report on surra in equines, bovines, buffaloes, and canines, etc. [Review of Lingard, 1899, by Railliet] <Rec. de. méd. vét., Par., 8. s., v. 8, 15. juin, pp. 377–378. [W^{a}.]

LIVINGSTON, DAVID.

1858a.—The tsetse. (*In his* Missionary travels and researches in South Africa, including a sketch of sixteen years' residence in the interior of Africa and a journey from the Cape of Good Hope to Loanda on the west coast, thence across the continent, down the river Zambesi to the eastern coast. 8°. New York. pp. 93–97, 612–613, figs. 1–3.) [W^{a}.]

1858b.—Arsenic as a remedy for the tsetse bite <Brit. M. J., Lond., n. s. (70), May 1, pp. 360–361. [W^{m}.]

LÜHE, MAX.

1900a.—Ergebnisse der neueren Sporozoenforschung. Zusammenfassende Darstellung, mit besonderer Berücksichtigung der Malaria-Parasiten und ihrer nächsten Verwandten <Centralbl., f. Bakteriol., Parasitenk. [etc.], Jena, 1. Abt., v. 27 (10–11), 23. März, pp. 367–384, figs. 1–9; (12–13), 31. März, pp. 436–460, figs. 1–9; v. 28 (6–7), 22. Aug., pp. 205–209; (8–9), 4. Sept., pp. 258–264, figs. 1–6; (10–11), 20. Sept., pp. 316–324, figs. 7–10; (12–13), 6. Okt., pp. 384–392. [W^{a}.]

[*Trypanosoma*, p. 443.]

1900b.—Ergebnisse der neuern Sporozoen-Forschung. Zusammenfassende Darstellung mit besonderer Berücksichtigung der Malariaparasiten und ihrer nächsten Verwandten. iv — 100 pp., 35 figs. 8°. Jena. [W^{a}.]

[Reprint of Lühe, 1900a, with additions.]

DE LUSTRAC, A.

1896.—*Trypanosoma Balbianii*, Certes <Actes Soc. Linn. de Bordeaux, v. 50, 5. s., v. 10, pp. 265–275, pls. 1–2. [W^{c}.]

MCWEENEY, E. J.

1899.—Reports on recent bacteriological and hygienic researches. II. Koch's work on the plague in Africa, tsetse fly disease, and Texas fever <J. State M., Lond., v. 7 (2), Feb., pp. 115–120. [W^{m}.]

MALKMUS, BERNARD.

1901.—Outlines of clinical diagnostics of the internal diseases of domestic animals, translated from the latest German edition by D. S. White & Paul Fischer. 205 pp., 45 figs. 8°. Chicago. [W^{c}.]

MAROTEL, G.

1902.—Les hématozoaires et leurs modes de transmission <J. de méd. vét. et zootech., Lyon, 5. s., v. 6, 28 fév., pp. 97–107. [W^{a}.]

MARSHALL, W.

1885.—Ueber die Tsetsefliege <Biol. Centralbl., Erlang., v. 5 (6), 15. Mai, pp. 183–184. [W^{m}.]

[MAUS, L. M.]

1902.—A new epidemic disease among horses in the Philippine Islands <Phila. M. J., v. 9 (4), Jan. 25, p. 149. [W^{a}.]

MAXWELL, THOMAS.

1857.—On "surrah" <Indian Ann. M. Sc., Calcutta, v. 4, Apr., pp. 441–447. [W^{m}.]

MAYER, A. F. I. CAROLUS.

1843.—Specilegium observationum anatomicarum de organo electrico in Raiis anelectricis et de Hæmatozois. 17 pp., 3 pls. 4°. Bonnæ. [W^{a}.]

MED. REC., N. Y.

1902a.—Surra among the army mules in the Philippines <Med. Rec., N. Y., v. 61 (6), Feb. 8, p. 221. [W^{a}.]

1902b.—Treatment and prevention of "surra" in horses, mules and other animals. [Review of circular, Jan. 11, Military Governor, Philippines] <Med. Rec., N. Y., v. 61 (11), Mar. 15, p. 420. [W^{a}.]

MÉGNIN, J. P.

1875a.—Mémoire sur la question du transport et de l'inoculation de virus par les mouches <J. de l'anat. et physiol. [etc.], Par., v. 11 (2), mars–avril, pp. 121–133, pl. 7. [W^{m}.]

1875b.—Du rôle des mouches dans la propagation du charbon et autres affections virulentes <J. de méd. vét. mil., Par., v. 12 (8), jan., pp. 461–475. [W^{m}.] [Tsétsé, pp. 471 ff.]

MESNIL, F. *See* Laveran, Alphonse, & Mesnil, F.

MITROPHANOW, P.

1883.—Beiträge zur Kenntniss der Hämatozoen. Neue monadenförmige Parasiten des Fischbluts, ihnen ähnliche Organismen und ihre Beziehung zu den Blutelmenten <Biol. Centralbl., Erlang., v. 3 (2), 15. März, pp. 35–44, figs. 1–2. [W^{m}.]

MÖBIUS, K.

1883.—*Trypanosoma Balbianii* Certes im Krystallstiel schleswig-holsteinischer Austern <Zool. Anz., Leipz., v. 4 (134), 19. März, p. 148. [W^{m}.]

DE NABIAS, B. *See* Jolyet, F., & de Nabias, B.

NARIMAN & VAZ.

1893.—The disease "surra" <Vet. J., Lond., v. 36, June, pp. 403–406. [W^{a}.] [No practical treatment found; excrements and breath highly offensive; sporadic cases in every season throughout the year; communicable to all species of domesticated animals (mammals); temperature in febrile attack 104° to 106° F.; symptoms; diagnosis; post-mortem appearances; treatment, inhalations of carbolic acid, 1 oz., in closed room, or hypodermic injections, 2 grains corrosive sublimate in a solution with common salt.]

NEPVEU, G.

1898.—Sur un Trypanosome dans le sang de l'homme <Compt. rend. Soc. de biol., Par., 10. s., v. 5 (41), 30 déc., pp. 1172–1174. [W[a].]

[Gives an alleged occurrence of *Trypanosoma* in man; description incomplete.]

NEUMANN, L. G.

1888.—Traité des maladies parasitaires non microbiennes des animaux domestiques. xv + 673 pp., 306 figs. 8°. Paris. [W[a].]

[Pp. 33–34, brief reference to tsetse fly, with quotation on the disease taken from Railliet; p. 557, brief reference to Künstler, 1883, p. 775.]

1892a.—Idem. 2. éd. xvi + 767 pp., 364 figs. 8°. Paris. [W[a].]

[Pp. 35–36, brief account of the tsetse fly, copied from Railliet; p. 631, brief reference to *Trypanosoma* in rabbit (Jolyet & de Nabias, 1891), and guinea pig (Künstler, 1883); p. 626 mentions *Trypanosoma sanguinis arium* of Danilewsky.]

1892b.—A treatise on the parasites and the parasitic diseases of the domesticated animals, translated and edited by George Flemming. xxiii, +800 pp., 364 figs. 8°. London. [W[a].]

[Pp. 34–36, brief account of tsetse fly, copied from Railliet; p. 619–622, surra; p. 635, *Trypanosoma* in rabbit (Jolyet & de Nabias, 1891), and in guinea pig (Künstler, 1883); p. 649 mentions *Trypanosoma sanguinis arium* of Danilewsky.]

NOCARD.

1901a.—Sur les rapports qui existent entre la dourine et le surra ou le nagana <Compt. rend. Soc. de biol., Par., v. 53 (16), 10 mai, pp. 464–466. [W[a].]

1901b.—Idem [reviewed] <Rec. de méd. vét., Par., 8. s., v. 8 (11), 15 juin, pp. 379–380. [W[a].]

NOCKOLDS, COLEMAN.

1901.—"Surra" in the Philippines <Am. Vet. Rev., N. Y., v. 25 (9), Dec., pp. 743–745. [W[a].]

1902.—Some further remarks on "surra" <Am. Vet. Rev., N. Y., v. 25 (11), Feb., pp. 900–903. [W[a].]

NUTTALL, GEORGE H. F.

1898.—Neuere Untersuchungen über Malaria, Texasfieber und Tsetsefliegenkrankheit. Zusammenfassender Bericht <Hyg. Rundschau, Berl., v. 8 (22), 15. Nov., pp. 1084–1102. [W[a].]

[An excellent digest of recent literature.]

1899.—Die Rolle der Insekten, Arachniden (*Ixodes*) und Myriapoden als Trägen bei der Verbreitung von durch Bakterien und thierische Parasiten verursachten Krankheiten des Menschen und der Thiere. Eine kritisch-historische Studie <Hyg. Rundschau, Berl., v. 9 (5), 1. März, pp. 209–220; (6), 15. März, pp. 275–289; (8), 15. Apr., pp. 393–408; (10), 15. Mai, pp. 503–520; (12), 15. Juni, pp. 606–620. [W[a].]

[An excellent critical digest of subject indicated in title; extensive bibliography; this paper should be read by all interested in the subject.]

OSBORN, HERBERT.

1896.—Insects affecting domestic animals; an account of the species of importance in North America, with mention of related forms occurring on other animals. Bull. No. 5, n. s., U. S. Dept. Agric., Div. Entom., 302 pp., 170 figs. 8°. Washington, D. C. [W[a].]

[Pp. 133–134, brief mention of the tsetse fly.]

OSLER, WILLIAM.

1887.—An address on the hæmatozoa of malaria <Brit. M. J., Lond., v. 1 (1367), Mar. 12, pp. 556–562, figs. 1–15. [W^{a}.]

[Refers to the work of Evans, Steel, Lewis, Crookshank, Mitrophanow and Danilewsky on surra and *Trypanosoma*.]

OSWELL, W.

1852.—Sur une mouche venimeuse de l'Afrique méridionale <Compt. rend. Acad. d. sc., Par., v. 35 (16), 2. sémestre, pp. 560–561. [W^{a}.]

1853.—Giftige Fliege in Süd-Africa. [Review of Oswell, 1852] <Repert. d. Thierh., Stuttg., v. 14, p. 367. [W^{m}.]

PEASE, H. J.

1897.—Surra and malarial fever <Veterinarian, Lond., v. 70 (838), Oct., pp. 549–565, figs. [W^{a}.]

[Caustic criticism of Burke, 1897; general discussion of surra, comparing it with other diseases.]

PENNING, C. A.

1900a.—Verdere Waarnemingen betreffende Surra in Nederl.-Indië <Veearts. Bladen v. Nederl.-Indië, Batavia, v. 13 (1), Mai, pp. 25–52, pl. 1. [W^{a}.]

1900b.—Verdere Waarnemingen betreffende Surra in Ned.-Indië. [Review of Penning, 1900a, by Tjaden] <Centralbl. f. Bakteriol., Parasitenk. [etc.], Jena, 1. Abt., v. 28 (18), 17. Nov., pp. 613–614. [W^{a}.]

PFEIFFER, L.

1889.—Beiträge zur Kenntniss der pathogenen Gregarinen. III. Ueber Gregarinose, ansteckendes Epitheliom und Flagellaten-Diphtherie der Vögel <Ztschr. f. Hyg., Leipz., v. 5 (3), 31. Jan., pp. 363–401, figs. 1–15, pl. 3. [W^{a}.]

PLIMMER, H. G., & BRADFORD, J. ROSE.

1899a.—A preliminary note on the morphology and distribution of the organism found in the tsetse fly disease <Veterinarian, Lond., v. 72 (861), Sept., pp. 648–657. [W^{a}.]

[Reprinted from Nature. Description of adult *Trypanosoma Brucii;* distribution of parasite in body; infectivity, life history.]

1899b.—Vorläufige Notiz über die Morphologie und Verbreitung des in der Tsetsekrankheit ("Fly Disease" oder "Nagana") gefundenen Parasiten. [Transl. of Plimmer & Bradford, 1899a] <Centralbl. f. Bakteriol., Parasitenk. [etc.], Jena, 1. Abt., v. 26 (14–15), 28. Okt., pp. 440–447. [W^{a}.]

[Description of "*Trypanosoma Brucii;*" its distribution in the body; blood of dead animals loses power of infection twenty-four hours after death; life cycle of parasite.]

RABINOWITSCH, LYDIA, & KEMPNER, WALTER.

1899.—Beitrag zur Kenntniss der Blutparasiten, speciell der Rattentrypanosomen <Ztschr. f. Hyg., Leipz., v. 30 (2), 18. Apr., pp. 251–294, pl. 2. [W^{a}.]

[Review of literature; morphology and development; longitudinal and transverse division; segmentation; infection experiments; active and passive immunity; infection by fleas.]

RAILLIET, ALCIDE.

1884.—Du rôle de la tsétsé dans la propagation des maladies <Bull. Soc. centr. de méd. vét., Par., v. 38, n. s., v. 2, pp. 79–80. [W^{a}.]

[*Glossina morsitans*, probably a carrier of infectious material rather than a poisonous insect.]

1893.—Traité de zoologie médicale et agricole. v. 1, 736 pp., 494 figs. 8°. Paris. [W^{a}.]

1895.—Idem. v. 2, pp. 737–1303, figs. 495–892. 8°. Paris. [W^{a}.]

[Pp. 787–788, *Glossina morsitans* and nagana, brief general discussion.]

RANKING, GEORGE.

1891a.—A preliminary note on the nature and pathology of the disease known as "surra" affecting horses and mules in India <Vet. J., Lond., v. 32, June, pp. 399–405. [W^{a}.]

[Surra is a disease of malarial origin; changes in blood, "echinosis," and plasmodic; claims to have found and cultivated a "bacillus;" describes spores which were also found in water. (*See also* Gunn, 1891, pp. 309–310.).]

1891b.—Surra in horses. [Reply to Gunn, 1891] <Vet. J., Lond., v. 33, Dec., pp. 402–403. [W^{a}.]

RATTIG, A.

(1875).—Über Parasiten des Froschblutes. Diss. 29 pp., 1 pl. Berlin.

RAYER, P.

1843.—Des vers qu'on rencontrée dans le sang de certains animaux <Arch. de méd. comp., Par., v. 1, pp. 40–45. [W^{m}.]

REBOURGEON.

1889.—Note sur le mal de Cadeiras (Vulgo: Quebra-bunda) <Rec. de méd. vét., Par., v. 66, 7. s., v. 6 (3), 15 fév., pp. 85-93. [W^{a}.]

REC. DE MÉD. VÉT., PAR.

1896.—Le Trypanosome du bœuf et les tsétsés <Rec. de méd. vét., Par., 8. s., v. 3 (7), 15 avril, p. 266. [W^{a}.]

[Review of article in Progrès by Régulato on observation by Legrain of a trypanosome in sort of varicose dilatations developed on external surface of pericardium of cow slaughtered at abattoir at Bougie; also mentions Bruce, 1894, Brit. M. J.]

RINGE, R. H.

1887.—"Surra" in grass-cutters' ponies <Quart. J. Vet. Sc. India, Madras, v. 6 (21), Oct., pp. 47–49, temperature chart. [W^{m}.]

ROGERS, LEONARD. [Indian Med. Service.]

1901.—The transmission of the *Trypanosoma Evansi* by horse flies, and other experiments pointing to the probable identity of surra of India and nagana or tsetse-fly disease of Africa. [Read before Tsetse-fly Committee, Roy. Soc., Feb. 14, 1901] <Proc. Roy. Soc., Lond., v. 58 (444), May 4, pp. 163–170. [W^{m}.]

ROSS, RONALD. *See* Brit. M. J.

ROST, E. R.

1901.—Report on the possibility of treating "surra" by infections of an anti-parasitic serum <J. Path. & Bacteriol., Edinb. & Lond., v. 7 (3), June, pp. 285–290. [W^{m}.]

ROUGET, J. [Algeria.]

1896.—Contribution à l'étude du Trypanosome des mammifères <Ann. de l'Inst. Pasteur, Par., v. 10 (12), déc., pp. 716–728, figs. 2, 3, 5. [W^{a}.]

[*Trypanosoma* in horse; description; inoculations of cold-blooded animals and birds negative; of guinea pig negative; positive in white and gray mice, white rat, rabbit, dog, results fatal; on sewer rats positive and negative; one case of possible transmission (rabbit) by coitus; ingestion experiments negative; horse from which original material came had dourine; serum-therapy.]

1900.—Sang coloré contenant des Trypanosomes <J. de méd. de Bordeaux, v. 30 (1), 7 jan., p. 12. [W^{m}.]

[Short communication on dourine.]

SALMON, DANIEL ELMER, & STILES, CH. WARDELL.

1902.—Emergency report on surra <Bull. No. 42, Bureau Animal Indust., U. S. Dept. Agric., Wash., pp. 1-130, figs. 1-112. [W[a].]

SCHALASCHNIKOFF [CHALACHNIKOW], A.

(1888).—Recherches sur les parasites du sang. Kharkov.

1889.—Izslied. nad Krovoparazit. cholod. i teplskrov. jivotnych. [Researches on parasitology of blood in cold and warm blooded animals] <Sborn. trud. Charkov. Vet. Inst., v. 1, pp. 195-304, 3 pls. [W[m].]

SCHNEIDEMÜHL, GEORG.

1896.—Lehrbuch der vergleichenden Pathologie und Therapie des Menschen und der Hausthiere für Thierärzte, Ärzte und Studirende. pp. 209-448. 8°. Leipzig. [W[a].]

[P. 268, very brief reference to surra, with confusion of pernicious anemia in man.]

SCHNEIDER, G. *See* Buffard, M., & Schneider, G.

SCHOCH, G. M. T.

1883.—Die Tsetsefliege Afrikas <Mitth d. schweiz. entom. Gesellsch., Schaffhausen, v. 6 (10), Oct., pp. 685-686. [W[a].]

SLEE, JOHN G.

1902a.—Notes on a new disease of horses <Am. Vet. Rev., N. Y., v. 25 (10), Jan., pp. 819-821. [W[a].]

1902b.—Idem <Bull. No. 42, Bureau Animal Indust., U. S. Dept. Agric., Wash., pp. 12-13. [W[a].]

SMITH, ALLEN M., & KINYOUN, J. J.

1901a.—A preliminary note on parasitic disease of horses. 3 pp., 2 photomicrographs (Army Pathological Laboratory), Manila, P. I. [W[m].]

1901b.—Idem. Reprint, with additions by Allen M. Smith. General Orders, No. 390, Headquarters Div. of Philippines, Manila, P. I., Dec. 11.

1902.—Idem <Bull. No. 42, Bureau Animal Indust., U. S. Dept. Agric., Wash., pp. 13-15. [W[a].]

SMITH, FRED.

1886.—Fieber <Encycl. d. ges. Thierh. u. Thierzucht, Wien & Leipz., v. 3, pp. 133-134. [W[a].]

STEEL, JOHN HENRY.

1881.—A treatise on the disease of the ox; being a manual of bovine pathology especially adapted for the use of veterinary practitioners and students. xxi + 498 pp., 116 figs. 8°. London. [W[a].]

(1885).—An investigation into an obscure and fatal disease among transport mules in British Burma.

1886a.—On relapsing fever of equines <Vet. J., Lond., v. 22, Mar., pp. 166-174, 1 fig.; Apr., pp. 248-257. [W[a].]

[Excellent short discussion on temperature; parasites, gross pathology in mules; transmission to dogs, case fatal; transmission to ordinary Burmese monkey, case fatal; compares the disease with relapsing fever of man, which he thinks is closely allied.]

1886b.—Fieber <Encycl. d. ges. Thierh. u. Thierzucht (Koch), Wien & Leipz., v. 3, pp. 134-137, fig. 539. [W[a].]

[Gives short discussion.]

1888a.—A veterinary glimpse at the last Burma war. [Editorial] <Quart. J. Vet. Sc. India, Madras, v. 6 (22), Jan., pp. 135-144. [W[m].]

1888b.—Le surra, maladie contagieuse des animaux domestiques, dans l'Inde <Rec. de méd. vét., Par., 7. s., v. 5 (9), 15 mai, pp. 298-304. [W[a].]

[Résumé of Steel, probably 1881-1882, not accessible to us.]

STILES, CH. WARDELL. (*See also* Salmon, Daniel Elmer, & Stiles, Ch. Wardell.)

1902.—*Trypanosoma* in a new rôle <Am. Med., Phila., v. 3 (6), Feb. 8, pp. 240–241. [W^{a}.]

STORDY, ROBERT J.

1899.—The Uganda transport—"through the tsetse fly belt of British East Africa" <Veterinarian, Lond., v. 72 (853), Jan., pp. 11–20, figs. 1–8, 1 map. [W^{a}.]

[Mules were given balls composed of arsenic, quinine, and gentian, then all animals smeared with solution of Jeyes fluid, and ponies arrayed in pajamas, see fig. 88.]

THEILER, A.

1901a.—Die Tsetse-Krankheit <Schweiz.-Arch. f. Thierh., Zürich, v. 43 (3), Mai–Juni, pp. 97–112; (4), Juli–Aug., pp. 153–162. [W^{m}.]

[P. 162. Incurable; quinine per os and subcutaneously; also arsenic and other drugs tried.]

1901b.—Idem. [Reviewed by Francke] <Berl. thierärztl. Wchnschr. (52), 26. Dez., pp. 794–796. [W^{a}.]

VALENTIN, G.

1841.—Ueber ein Entozoon im Blute von *Salmo fario* <Arch. f. Anat., Physiol. u. wissensch. Med., Berl., pp. 435–436, pl. 15, fig. 16. [W^{m}.]

VAZ. *See* Nariman & Vaz.

VETERINARIAN, LOND.

1890.—Notes on "surra" <Veterinarian, Lond., v. 63 (745), Jan., pp. 1–3. [W^{a}.]

[Brief editorial, referring to Burke, Lewis, Crookshank, Steel, Cunningham, and Carter.]

1891.—Surra <Veterinarian, Lond., v. 64 (759), Mar., pp. 169–170. [W^{a}.]

[Short note quoted from The Field, Lond.]

VET. J., LOND.

1889.—The tzetze fly and man <Vet. J., Lond., v. 28, Feb., pp. 140–141. [W^{a}.]

[Cause a condition resembling urticaria, intense itching at night, and preventing sleep.]

1894.—The disease surra in solipeds and camels. [Review of Lingard, 1893, v. 1] <Vet. J., Lond., v. 38, Mar., pp. 172–175. [W^{a}.]

1896.—Surra. [In part, a review of Lingard, 1895] <Vet. J., Lond., v. 42 (249), Mar., pp. 177–183. [W^{a}.]

VOGES, O.

1901a—Das Mal de Caderas der Pferde in Südamerika <Berl. thierärztl. Wchnschr. (40), 3. Okt., pp. 597–598. [W^{a}.]

1901b.—Le Mal de Caderas des chevaux dans l'Amérique du sud. [Review of Voges, 1901a, by Railliet] <Rec. de méd. vét., Par., 8. s., v. 8 (23), 15 déc., pp. 788–789. [W^{a}.]

1902.—Das Mal de Caderas <Ztschr. f. Hyg. u. Infectionskrankh., Leipz., v. 39 (3), 13. März, pp. 323–372, pl. 5, figs. 1–7. [W^{a}.]

VRIJBURG, A.

1900.—Surra <Veearts. Bladen v. Nederl.-Indië, Batavia, v. 13 (1), Mai, pp. 53–58. [W^{a}.]

1902.—Surra <Veearts. Bladen v. nederl.-Indie, Batavia, v. 14 (3), pp. 207–215, 1 pl. [W^{a}.]

WALLEY, RALPH ST. JOHN.

1893.—Surra in fox-hounds <J. Comp. Path. & Therap., Edinb. & Lond., v. 6 (3), Sept. 30, pp. 285–286. [W^{a}.]

WEDL, C.

1850.—Beiträge zur Lehre von den Hämatozoen <Denkschr. d. k. Akad. d Wissensch., math.-nat. Cl., Wien, v. 1, 2. Abt., pp. 15–25, 1 pl. [W^{a}.]

WEICHSELBAUM, ANTON.

1898.—Parasitologie <Handb. d. Hyg., Jena, v. 9, Lief. 2, pp. x+63–336, figs. 1–78. [W^{a}.]

[*Trypanosoma sanguinis*, p. 285.]

WILLIAMS, WILLIAM.

1892.—The principles and practice of veterinary medicine. 3. ed., pp. xix+833, 36 figs., 7 pls. 8°. London, Edinburgh, & Glasgow. [W^{a}.]

WILSON-BARKER, J.

1892.—Maladie-du-coït in Nebraska <Vet. J., Lond., v. 35, Dec., pp. 424–429 [W^{a}.]

[Character; symptoms in mare; symptoms in stallion; autopsy.]

1893.—Maladie-du-coït <Vet. J., Lond., v. 36, June, pp. 406–408. [W^{a}.]

[Symptoms presented by stallions.]

WITTICH.

1881.—Spirillen im Blute von Hamstern <Centralbl. f. d. med. Wissensch., Berl., v. 19 (4), 22. Jan., pp. 65–66. [W^{m}.]

ZIEMANN, HANS.

1898.—Eine Methode der Doppelfärbung bei Flagellaten, Pilzen, Spirillen und Bakterien, sowie bei einigen Amöben <Centralbl. f. Bakteriol., Parasitenk. [etc.], Jena, 1. Abt., v. 24 (25), 30. Dez., pp. 945–955, pl. 9. [W^{a}.]

1900.—Zweiter Bericht über Malaria und Moskitos an der afrikanischen Westküste. [Nach einem Vortrage im Institut Pasteur, 6. Aug., 1900, auf dem internationalen medicinischen Congress in Paris] <Deutsche med. Wchnschr., Leipz., v. 26 (47), 22. Nov., pp. 753–756; (48), 29. Nov., pp. 769–772. [W^{a}.]

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U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF ANIMAL INDUSTRY—BULLETIN No. 43.

D. E. SALMON, D. V. M., Chief of Bureau.

STATE AND TERRITORIAL LAWS

RELATING TO

CONTAGIOUS AND INFECTIOUS DISEASES OF ANIMALS.

1901.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1902.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
Washington, D. C., July 22, 1902.

SIR: I have the honor to transmit herewith copies of State and Territorial laws relating to contagious and infectious diseases of animals which were enacted during the year 1901, and suggest that these be published as Bulletin No. 43 of this Bureau. Heretofore it has been the custom to publish these laws biennially in the report of this Bureau, but they have become so voluminous that they take up much space in that volume which it is deemed can be better utilized for articles of more general interest. While it is important that these laws be published, it is believed that a limited edition in bulletin form will answer all requirements.

Respectfully,

D. E. SALMON,
Chief of Bureau.

Hon. J. H. BRIGHAM, *Acting Secretary.*

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LAWS FOR THE CONTROL OF CONTAGIOUS DISEASES OF ANIMALS.

ARIZONA.

AN ACT Entitled "An act to amend an act to codify and revise the laws with reference to live stock," being act 6, of the nineteenth legislative assembly of the Territory of Arizona.

Be it enacted by the Legislative Assembly of the Territory of Arizona:

Amending law of 1897. SECTION 1. Amend section 2, eighth line, by striking out the words "twelve hundred" and insert in place thereof "eighteen hundred."

SEC. 2. Amend section 15, last line, by striking out the word "fifty" and insert in place thereof "one hundred."

SEC. 3. Amend section 37 to read as follows:

Slaughter license, bond, etc. "Any person or persons, firm, or corporation engaged in the slaughter of live stock for sale in this Territory, shall slaughter all such animals in a fixed and definite slaughterhouse or slaughter pen, to be kept by such person or persons for that purpose; and before such person, persons, firm, or corporation shall begin, enter upon, or carry on the business of slaughtering any neat or horned cattle, swine, sheep, or goats for sale, or for the sale of meat, or selling or exposing for sale the meat of such animals in the Territory of Arizona, such person, persons, firm, or corporation shall first procure from the live stock sanitary board a license to operate such slaughtering business, and to sell or expose for sale such meat, under the conditions and upon payment of the fees herein provided, and after procuring such license, and before engaging in such business, such person, or persons shall execute upon a blank form furnished by the said board a bond with two or more good and sufficient sureties to the Territory of Arizona in the penal sum of one thousand dollars ($1,000), to be approved by the chairman of the board of supervisors of the county in which such business is to be carried on, conditioned that such person, persons, firm, or corporation shall not slaughter or expose for sale any neat animal or the meat thereof without first being the legal and equitable owner thereof, as well in law as in fact, and in case such person, persons, firm, or corporation shall slaughter or sell or expose for sale any neat animal, or the meat thereof as aforesaid, shall pay therefor double the value of any such animal, the same to be recovered by action on the said bond in the name of the true owner of such animal; the amount so recovered shall be paid as follows: One-half to the owner of such animal, one-fourth to the inspector or person discovering the wrongful possession or slaughtering of such animal, and the remaining one-fourth to the license and inspection fund herein provided for; and the compliance with all the provisions of this act applying to butchers.

"The live stock sanitary board shall grant to each and every applicant therefor, upon the payment of the fees herein provided, a license to slaughter horned and neat cattle, swine, sheep, and goats as may be set forth in such application for the term of one year from the date that such license is granted. If the business is to be carried on within, or within four miles of, any town of more than five thousand inhabitants, the applicant shall pay to the board the sum of one hundred and fifty dollars ($150) for a license to operate such business of slaughtering, at a fixed and definite slaughtering place; in case the business is to be carried on within, or within four miles of, any town or village of more than three thousand and less than five thousand inhabitants, the applicant shall pay to the board one hundred and twenty dollars ($120) for such slaughtering license; in case the business is to be carried on within, or within four miles of, any town or village of over one thousand and ess than three thousand inhabitants, the applicant shall pay to the board ninety dollars

($90) for such slaughtering license; and in all other cases thirty dollars ($30) for such slaughtering license: *Provided*, That all persons, firms, or corporations engaged in the said business prior to the passage of this act shall be allowed thirty days from and after the passage of this act in which to procure such license and file such bond. Each and every license issued under this act shall be for one specific place of business, and the location of the place of business for which it is issued shall be stated therein.

"The applicant for such license shall make written application to the board therefor, and state in his application where his slaughterhouse or slaughter pen is or will be located during the term for which such license is issued, and he shall not, during the term for which such license is issued, slaughter any neat or horned cattle, swine, sheep, or goats at any other place than that specified in his license: *Provided*, That if for any reason the holder of a license desires to change the location of any such slaughtering place he shall apply to the said board to have such license transferred to cover such change. And said board shall reissue such license on application therefor for the unexpired term of such license: *Provided*, That any person, persons, firm, or corporation who shall slaughter or cause to be slaughtered more than two head of cattle or more than six head of hogs, sheep, or goats for the sale of meat in any one month shall be considered butchers within the meaning of this act."

SEC. 4. Amend section 39, in the eleventh line, by striking out the word "twenty," and in the thirteenth and fourteenth lines by striking out the words "which amount shall be deducted from the purchase price," and in the fifteenth line by striking out the word "ages."

SEC. 5. Amend section 40, the tenth line, by striking out the word "twenty."

SEC. 6. Amend section 41 to read as follows:

License and inspection fund. "All moneys received by the board for the licenses provided for in this act shall be turned over to the Territorial treasurer to be deposited in a special fund, to be known as the 'license and inspection fund,' and such fund shall be subject only to warrants drawn by the Territorial auditor on demand of the chairman of the live stock sanitary board, duly countersigned by the secretary, for the payment of slaughterhouse inspectors: *Provided*, That no slaughterhouse inspector shall receive less than fifty per cent or more than ninety per cent per annum of all such license fees paid from or within his district. Such payments to be made quarterly, and any and all balance remaining in such fund after paying such warrants shall, at the end of each fiscal year, be turned over to the general fund of the Territory, on demand of the said board.

Untagged hides must not be purchased. "It shall be unlawful for any trader or other person to purchase or otherwise acquire possession of any hide of horned or neat cattle until the same shall have been inspected and tagged, as required by the provisions of this act, and the possession of any untagged hide shall be considered prima facie evidence of a misdemeanor, unless the person possessing such hide can show that the same was taken from an animal owned by him at the time of slaughter or death, or that he had written authority from the owner to remove such hide from the animal."

SEC. 7. Amend section 42, in the sixth and seventh lines, by striking out the words "ages and weight."

SEC. 8. Amend section 43, first line, by striking out the words "railroad company," and insert in place thereof the words "person or common carrier," and in the third and fourth lines by striking out the words "railroad company" and inserting in place thereof the words "person or common carrier."

SEC. 9. Amend section 44 to read as follows:

Owners must have mark and brand. "Every person, firm, company, or corporation owning horses, mules, asses, or neat cattle in this Territory shall have and adopt a mark and brand for such animals, and every person, firm, company, or corporation owning sheep and goats in this Territory shall have and adopt an earmark or brand, or both, different from his neighbor, and, as far as practicable, different from any other earmark or brand in the Territory, by which they [the animals] shall be marked and branded, after such earmark or brand shall have been recorded as required by this act: *Provided*, That any and all brands and earmarks of sheep and goats now on record in the office of the live-stock sanitary board are hereby legalized."

SEC. 10. Amend section 58 by inserting the words "upon demand of purchase" at the beginning of section.

SEC. 11. All the acts and parts of acts in conflict with this act are hereby repealed.

SEC. 12. The repeal of the foregoing sections, acts, and parts of acts shall in no way affect any rights that have accrued, or any actions pending.

SEC. 13. This act shall take effect and be in force from and after its passage.

Approved March 21, 1901.

REVISED STATUTES, 1901. TITLE 42. LIVE STOCK.

Live-stock sanitary board. SECTION 1. Three commissioners identified with and experienced in the live-stock interests of the Territory of Arizona shall be appointed by the governor, with the advice and consent of the legislative council, who shall constitute the live-stock sanitary board of the Territory of Arizona.

Qualification of members. SEC. 2. Before entering upon the duties of his office each commissioner shall take and subscribe to the oath of office according to law, and file the same with the secretary of the Territory; and each commissioner before entering upon the performance of his duties shall execute a bond in the sum of two thousand dollars ($2,000), conditioned that he will faithfully perform the duties of his office, which bond shall be approved by the governor and filed in the office of the secretary of the Territory.

Term of office. The term of office of the first commissioner named by the governor shall be for three years from the first day of April, 1897; the second one named shall be for two years, and the third one named shall be for one year from said first day of April, 1897, and the successors of each shall be appointed for the term of three years thereafter. The governor shall have power to fill vacancies in said board. Said board shall elect one of their number chairman. The board shall keep a full and complete record of their proceedings, and make such report to the governor as may from time to time be required, and a biennial report to the legislative assembly, such report to be made in triplicate.

Salary. The members of the board appointed by the governor as hereinbefore provided shall receive ten dollars ($10) per day for the time by them necessarily employed in discharging the duties required by this title: *Provided, however*, That in no one year shall the board be in session more than sixty days, except upon call of the governor; and each member of the board shall receive five (5) cents for each and every mile actually traveled, which per diem and mileage shall be paid on the warrant of the auditor, to be issued on the filing of an itemized account therefor in the auditor's office, properly certified thereto by such member, duly countersigned by the secretary, with the seal of the board and approval of its chairman; but before any mileage shall be allowed or paid, the one claiming the mileage shall make and file with the territorial auditor his affidavit, stating the distance traveled, the most direct route from his home to the place of the meeting of the board.

Veterinary surgeon. SEC. 3. The governor shall nominate and, by and with the advice and consent of the legislative council, appoint a skilled veterinary surgeon for the Territory of Arizona, who, at the date of such appointment, shall be a graduate in good standing of a recognized college of veterinary surgeons, and who shall hold his office for the term of two years, unless sooner removed by the board; the salary of said veterinary surgeon shall be the sum of eighteen hundred dollars ($1,800) per annum, and ten (10) cents per mile for each mile actually and necessarily traveled in the discharge of his duties. Before entering upon the discharge of his duties, the territorial veterinarian shall take and subscribe an oath to faithfully perform the duties of his said office, and shall execute a bond to the Territory of Arizona in the sum of five thousand dollars ($5,000), with good and sufficient sureties, conditioned for the faithful performance of the duties of his office, which bond and sureties thereto shall be approved by the governor; and said bond, together with his oath of office, shall be deposited in the office of the secretary of the Territory.

Owners to report disease. SEC. 4. It shall be the duty of any owner or person in charge of any domestic animal or animals, who discovers, suspects, or has reason to believe that any of his domestic animals, or domestic animals in his charge, are affected with any infectious or contagious disease, to immediately notify such fact, belief, or suspicion to the board or any member of it, or to the Territorial veterinarian; and it shall be the duty of any person who discovers the existence of any contagious or infectious disease among the domestic animals of another to report the same to the said board or Territorial veterinarian, and

any attempt to conceal the existence of such disease, or to wilfully or maliciously obstruct or resist said board or the Territorial veterinarian in the discharge of their duties, as herein set forth, shall be deemed a misdemeanor.

Duties of board. SEC. 5. It shall be the duty of the board provided for in the first section of this title to protect the health of the domestic animals of the Territory from all contagious and infectious diseases of a malignant character, and for this purpose it is hereby authorized and empowered to establish, maintain, and enforce such quarantine, sanitary, and other regulations, including methods of disinfecting railroad cars, as it may deem necessary. It shall be the duty of any member of said board, upon receipt by him of reliable information of the existence among the domestic animals of the Territory of any malignant disease, to immediately notify the Territorial veterinarian, who shall go at once to the place where any such disease is alleged to exist, and make a careful examination of the animals believed to be affected with any such disease, and ascertain, if possible, what, if any, disease exists among the live stock reported to be affected, and whether the same is contagious or infectious or not, and if said disease is found to be of a malignant, contagious, or infectious character he shall direct a temporary quarantine and sanitary regulations necessary to prevent the spread of any such disease, and report forthwith his findings and action to the chairman of the board.

Action of board. SEC. 6. Upon the receipt of [by] the chairman of the board of the report of the Territorial veterinarian provided for in the next preceding section, he shall immediately, if the exigencies of the case require it, convene the board at the most convenient place, and, if upon consideration of the report of the veterinarian, the board shall be satisfied that any contagious or infectious disease exist which seriously affects the health of domestic animals, they shall, after ascertaining and determining the extent of premises or grounds infected, authorize the veterinarian to establish the quarantine, sanitary and police regulations necessary to circumscribe and exterminate such disease; and no domestic animal liable to become infected with the disease, or capable of communicating the same, shall be permitted to leave the district, premises, or grounds so quarantined, except by the authority of the veterinarian. The said board shall prescribe such rules and regulations as will enable the veterinarian to perfectly isolate the disease and exposed animals from all other domestic animals which are susceptible of becoming infected with the disease; they shall also, from time [to time] prescribe and enforce such directions, rules, and regulations as to separating, mode of handling, treating, feeding, and caring for such infected or diseased and exposed animals as it shall deem necessary to prevent the two classes of animals from coming in contact with each other, and the said board or any of the members thereof, or said veterinarian, are hereby authorized and empowered to enter upon any grounds or premises to carry out provisions of this title.

Quarantine, etc. SEC. 7. When the said board shall have determined the quarantine and other regulations necessary to prevent the spread among domestic animals of any maligant, contagious, or infectious disease found to exist among the live stock of the Territory, and given its orders as hereinbefore provided, prescribing quarantine and other regulations, it shall notify the governor thereof, who shall issue his proclamatian, proclaiming the boundary of such quarantine, and the orders, rules, and regulations prescribed by the board, which proclamation may be published by written or printed handbills posted within the boundaries or on the lines of the district, premises, places, or grounds so quarantined, or by being published in the stock papers of the Territory: *Provided*, That if the board decides that it is not necessary, by reason of the limited extent of the district in which such disease exists, that a proclamation should be issued, then none shall be issued, but the board shall give such notice as to it shall seem best to make the quarantine established effective.

Slaughter of animals. SEC. 8. In any case of epidemic disease where premises have been previously quarantined by the Territorial veterinarian, as before provided, he is further authorized and empowered, when in his judgment necessary, by and with the consent of the said board, to order the slaughter of any or of all diseased animals upon said premises, and of all animals that have been exposed to contagion or infection, under the following restrictions: The order for slaughter shall be in writing, and shall be made in duplicate; and there shall be a distinct order and a duplicate for each owner of the animal or animals condemned, the original of each order to be filed in the office of the said board and the duplicate given to the said owner. And further, before slaughtering any animal or animals that have been exposed only and do not show disease, the veterinarian shall call in

consultation with him two reputable practicing veterinarians or physicians, residents of the Territory, or if this is impracticable, then two reputable and well-known stock owners, residents of the Territory, and shall have the written endorsement upon his orders of at least one of said consulting physicians or stock owners stating that said action is necessary, and the consent in writing of the owner or person in charge, before such animal or animals shall be slaughtered. It shall be the duty of the Territorial veterinarian to superintend the slaughtering of such animals as may be condemned, and also the destruction of the carcass, causing the same to be destroyed as cheaply as practicable, which destruction shall be by burning to ashes, and shall include every part of the animal and hide, and also excrement and stable bedding or corral litter, as far as possible.

Penalty for disposing of diseased animals.

SEC. 9. Any person, persons, firm, or corporation who shall have in his possession any domestic animal affected with any contagious or infectious disease, knowing such animal to be so affected, or, after having received notice that such animal is so affected, who shall sell, drive, ship, trade, or give away such diseased animal or animals which have been exposed to such infection or contagion, sheep infected with scab upon the range excepted, or who shall move or drive any domestic animal in violation of any direction, rule, regulation, or order establishing and regulating quarantines, shall be deemed guilty of a misdemeanor: *Provided*, That any owner of any domestic animal which has been affected with or exposed to any contagious or infectious disease may dispose of the same after having obtained from the Territorial veterinarian a bill of health of such animal. It shall be unlawful to kill for butcher purposes any diseased animal, to sell, give away, or use any part of it, or its milk, or to remove any part of the skin.

Quarantine against other States.

SEC. 10. Whenever the said board shall have good reason to believe that any contagious or infectious disease exists in any other State, Territory, or countries, or that there are conditions that render domestic animals from such districts liable to convey such disease, they shall report the same to the governor. Thereupon the governor shall by proclamation prohibit the importation of any live stock of the kind diseased in the Territory, unless accompanied with a certificate of health given by a duly authorized State or Territorial veterinarian; and all such animals arriving in this Territory shall be examined upon arrival by the Territorial veterinary surgeon, and if deemed necessary placed in close quarantine until all danger of infection is passed, when they shall be released by order of the Territorial veterinarian. All expense connected with such examination shall be paid by the owner or owners of such stock.

Transportation of diseased animals.

SEC. 11. It shall be unlawful for any person, persons, firm, or corporation to drive or transport or cause to be driven or transported into the Territory of Arizona any live stock from those States, Territories, or countries against which the governor has proclaimed a quarantine, as hereby provided for in the preceding section: *Provided*, That cattle in transit through the Territory on a railroad, when not unloaded, are not liable to any penalties attached to this title; otherwise the regulations contained herein shall apply as well to those animals in transit through the Territory as to those resident therein; and the said board, a member thereof, or the Territorial veterinary surgeon shall have full authority to examine, whether in yards or pasture or stables or upon the public domain, all animals passing through the Territory or any part of it, and, on detection or suspicion of disease, to take possession of and treat and dispose of said animals in the same manner as is prescribed for animals resident in the Territory.

Penalty for importing diseased animals.

SEC. 12. Any person, persons, firm, corporation, owner, or agent who shall knowingly bring into this Territory any domestic animal or animals infected with any contagious or infectious disease, or any animal or animals which have been exposed to any contagious or infectious disease, shall be deemed guilty of a misdemeanor.

General penalty for evading this title.

SEC. 13. Except as otherwise provided in this title, any person, persons, firm, corporation, owner, or agent who shall violate, disregard, or evade or attempt to violate, disregard, or evade any of the provisions of this title, or who shall violate, disregard, or evade, or attempt to violate, disregard, or evade any of the rules, regulations, orders, or directions of the said board establishing and governing quarantine, shall be deemed guilty of a misdemeanor; and any person, persons, firm, corporation, owner, or agent who violate any of the provisions hereof shall be guilty of a misdemeanor, and, upon conviction thereof in any court of competent jurisdic-

tion, shall be fined not less than fifty ($50) nor more than three hundred dollars ($300), and shall be liable for any damage that may be sustained by reason of their failure to comply with the provisions of said sections.

Board may employ assistance. SEC. 14. The said board shall have the power to employ such persons and purchase such supplies and material as may be necessary to carry into full effect all orders by it given, as hereinbefore provided; that no laborer shall be employed, or material or supplies purchased by the said board, except such additional labor, material, and supplies as may be necessary to carry into effect the quarantine and other regulations prescribed by the said board.

Officers must obey orders of board. SEC. 15. The said commissioners shall have the power to call upon any sheriff, under sheriff, deputy sheriff, constable, cattle inspector, or detective to execute their orders, and such officers shall obey the orders of said board; and the officers performing such duties shall receive compensation therefor as is prescribed by laws for like services; and any officer may arrest on view, and take before any magistrate of the county any person found violating any of the provisions hereof; and such officer shall immediately notify the district attorney of such county of such arrest, and he shall prosecute the person so offending according to law.

Board to protect stock. SEC. 16. The board is hereby authorized, and it is made its duty, to exercise a general supervision over, and so far as may be to protect the stock interests of the Territory from theft; and in furtherance of this object the said board shall devise and recommend from time to time such legislation as in their judgment will foster this important industry; and shall appoint such inspectors as they may deem necessary for the better protection of the live-stock interests of the Territory.

Inspectors. Said inspectors shall be under the exclusive direction and control of the board, and shall report to it all their official acts, as prescribed in the rules and regulations of the board.

Secretary of board. The board shall cause to be kept in a safe place a permanent record of their own acts, and of all official reports of inspectors, and may appoint a secretary and pay him, for the clerical work and keeping the records of the inspection service, a sum not exceeding one hundred dollars ($100) per month.

System of inspection. SEC. 17. The board shall devise a system of inspection for health and for marks and brands of all stock exported from the Territory, of all stock slaughtered in the Territory, and of all stock that may be driven from one range to another in the Territory; and shall prescribe rules and regulations for the seizure and selling of stray stock in the brand of unknown owners; and all stock running in unrecorded brands; for discovering unknown owners, and for remitting to them the proceeds of such sale, if such owners be the bona fide and lawful owners thereof. They shall furnish suitable blanks in triplicate, upon which all inspectors shall keep a record of their inspection, and upon which they shall report to the board all inspections made; the inspection reports, whether in the hands of the inspector or in the office of the board, shall at all times be open to any person or persons desiring to examine them, and the secretary of the board shall give to any person inquiring, any desired information obtainable from the inspection records.

Powers of inspectors. SEC. 18. The inspectors are empowered, and it shall be their duty, to arrrest all persons who violate the stock laws of this Territory, and shall, upon information that any person or persons have committed any crime or misdemeanor against the laws of this Territory, in feloniously marking or branding any stock, or other crime or misdemeanor under the laws of this Territory, for the protection of the rights and interests of stock owners, make the necessary affidavit for the arrest and examination of such person or persons; and shall, only upon warrants issued therefor by any officer authorized to issue the same, immediately arrest such person or persons and bring them before the proper officer, to be dealt with according to law, and shall make due return of said warrant, and notify the board of his acts and doings in that behalf; and it shall be the duty of the board in every proper way to assist in the prosecution and conviction of any and all persons guilty of any of the crimes and misdemeanors against the laws of this Territory in feloniously marking or branding or stealing any stock, or other crime or misdemeanor under any of the laws of this Territory for the protection of the rights and interests of stock owners.

Accounts. SEC. 19. All accounts shall be presented to the board, accompanied with triplicate vouchers, two of which shall be filed in the office of the board; they shall be examined, considered, and approved for payment, if ascertained to be correct, and thereupon certified by the chairman, and countersigned by the secretary to the Territorial auditor, setting forth each item covered in said certificate. The Territorial auditor shall then draw his warrant on the Territorial treasurer for the respective amount set forth in each specified account, and the treasurer shall pay the same as other Territorial warrants are paid: *Provided*, That no warrant shall be issued in payment for the printing of the reports of the live-stock sanitary board.

Unclaimed funds. SEC. 20. Whenever any funds, received by the board from the sale of stock, shall have remained in its possession for twelve months without any owner thereof having been found, it shall be the duty of the chairman of the board to pay the same to the Territorial treasurer, to be by him placed to the credit of the general fund of the Territory.

Must appoint inspectors. SEC. 21. It is the duty of the board upon a petition signed by not less than twenty-five persons, each of whom shall be interested and engaged in the business of owning and breeding live stock in the Territory of Arizona, to appoint stock inspectors who shall hold their offices at the will and pleasure of the board.

Duties of inspectors. SEC. 22. It is the duty of inspectors, under rules and regulations prescribed by the board, to inspect for health and for marks and brands, at the railway loading stations, at the place of exit from the Territory, and at all places where neat cattle are gathered to be driven off their range for any purpose, or that are being driven away from their usual range, wheresoever and whensoever the inspector shall encounter them or designate, all neat cattle about to be or which are being shipped, gathered, or driven from any place in the Territory to any other place either in or out of the Territory, and to require from the owner or owners, person or persons in charge of such stock a list of the brands and marks, and to make sure by inspection that any and all live stock being shipped or driven as aforesaid is not stolen property, and that the person or persons in charge are the owners thereof, or are properly authorized in writing to handle such stock. The inspector shall make a permanent record of such inspection, showing the place and date of making the same, the name of the owner or owners, the person or persons in charge of said stock, the kind and description of stock, together with the number in each brand and mark, and all other and further necessary information, which said record shall be open for inspection by all persons desiring to inspect the same. A duplicate record of all inspections shall be sent to the board at such times and under such rules and regulations as the board may adopt. If on such inspection cattle shall be found not belonging to the shipper or to the driver, which he is not authorized in writing to ship or drive, all such cattle shall be taken by the inspector and dealt with in accordance with the rules of the board in such case made.

Oath and bond of inspectors. SEC. 23. Any person who shall receive appointment to be inspector, before entering upon the performance of his duties, shall take the oath of office prescribed by law, and shall file a bond in the sum of five hundred dollars ($500) with the county recorder of the county wherein he resides, running in the name of the Territory, executed by himself, and at least two good and sufficient sureties, which bond shall be approved by the chairman of the board of supervisors of said county, conditioned upon the faithful performance of the duties of his office.

Liability of inspectors. SEC. 24. Any inspector who shall knowingly give or make a false certificate, or shall, without good cause, refuse to give a certificate of inspection, or shall accept any bribe for failure to perform any of the duties prescribed by law, or who shall give a certificate of inspection before receiving his fees for such inspection, or wilfully delay in making inspection when notified, shall be liable with his sureties on his official bond to the injured parties for all damages arising therefrom.

Prompt inspection. SEC. 25. Every inspector must inspect all live stock subject to inspection immediately, except when such inspector is engaged elsewhere in a like duty, upon being advised or informed that the same are subject to inspection, and when inspected the one in charge thereof shall at once pay to the inspector therefor five (5) cents per head for horses and neat cattle; two (2) cents per head for hogs; whereupon the inspector shall certify in writing to the owner or person in charge, on form furnished by the board, that said stock has been inspected according to law for marks and brands.

Arrest for driving strange cattle. SEC. 26. Any person, not being the owner, or having the right of possession of any animal or animals who shall be found driving any such animal or animals off its or their usual range without the consent of the owner or owners thereof shall be deemed guilty of larceny, and shall be arrested by the inspector, or by any constable, officer, or other person specially deputized for that purpose by a judge or justice of the peace, and such person or persons shall be taken before a magistrate for examination.

Transportation before inspection illegal. SEC. 27. It shall be unlawful for any common carrier to receive any live stock for transportation until the same shall have been inspected as required herein and until such common carrier shall have been furnished with a certificate by a duly authorized inspector, showing that the brands and earmarks on such live stock have been duly inspected as required by law. Any common carrier, or any officer, agent, or servant thereof who shall violate the provisions of this section shall be deemed guilty of a misdemeanor and, on conviction thereof, shall be fined not less than one hundred dollars ($100) and not more than five thousand dollars ($5,000), in the discretion of the court.

Penalty. SEC. 28. Any person violating any of the provisions hereof shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be punished by a fine not exceeding three hundred dollars ($300), or by imprisonment in the county jail not exceeding six months, or by both such fine and imprisonment.

Close season for Texas fever. SEC. 29. No person shall, between the first day of February and the first day of December of any year, drive or cause to be driven into or through any county or part thereof in this Territory, or turn loose or cause to be turned upon or kept in any highway, range, common, or enclosed pasture within this Territory any cattle capable of communicating or liable to impart what is known as Texas, splenetic, or Spanish fever. Any person violating any provisions of this section shall upon conviction thereof be adjudged guilty of a misdemeanor, and shall for each offense be fined not less than one hundred dollars ($100) and not more than two thousand dollars ($2,000), or be imprisoned in the county jail not less than thirty days and not more than one year, or by both such fine and imprisonment.

Penalty for moving affected cattle. SEC. 30. No officer, agent, employee, servant, or other person connected with or employed in the business of operation of any railroad, common carrier, or other transportation company or association shall ship or cause or permit to be shipped, or transport or cause or permit to be transported by means of the transportation afforded by such common carrier, railway, or other transportation corporation, company, or association, or deliver to any consignee or other person between the first day of February and the first day of December of any year, within this Territory, any cattle capable of communicating or liable to impart what is known as Texas, splenetic, or Spanish fever. Any person connected with or employed in the business or operation of any railway, common carrier, or other transportation company, corporation, or association, violating any of the provisions of this section, shall upon conviction thereof be adjudged guilty of a misdemeanor, and shall for each offense be fined not less than five hundred dollars ($500) nor more than two thousand dollars ($2,000), or be imprisoned in the county jail not less than thirty days nor more than one year, or by both such fine and imprisonment:

Cattle passing through exempted. *Provided*, That cattle in transit in cars through this Territory on any railroad, and not unloaded, are not liable to the penalties attached to this section.

Officers may quarantine upon complaint. SEC. 31. It shall be the duty of any sheriff, undersheriff, deputy sheriff, or live-stock inspector within this Territory, upon a complaint made to him by any citizen of the Territory, or otherwise having notice or knowledge that there are within the county where such officer resides cattle believed to be capable of communicating or liable to impart the disease known as Texas, splenetic, or Spanish fever, to forthwith take charge of and restrain such cattle under such temporary quarantine regulations as will prevent the communication of such disease and make immediate report thereof to the said board, and such officer shall keep such cattle in custody as aforesaid until released by order of said board, and no officer who shall take or detain any cattle under the provisions of this statute shall be liable to the owner of such cattle for any damage by reason of such detention or taking, or by reason of the performance of any other duty enjoined by this section.

Owners must pay cost of quarantine.

SEC. 32. Whenever said board shall determine that certain cattle within the Territory are capable or liable to impart Texas, splenetic, or Spanish fever, they shall issue an order to the sheriff or any constable or live-stock inspector of the county in which such cattle are found, commanding him to take and keep such cattle in his custody, subject to such quarantine regulations as they may prescribe until the first of December next ensuing, on which date they shall direct such officer to deliver such cattle to their owners or agents: *Provided, however*, That before any cattle so held shall be delivered as aforesaid there shall be paid to said board all the costs and expenses of taking, detaining, and holding said cattle, and in case such costs and expenses are not paid within ten days after the first day of December, the said officer shall advertise, in the same manner as is by law provided in cases of sales of personal property, that he will sell such cattle or such portion thereof as may be necessary to pay such costs and expenses of the sale, and at the time and place so advertised, he shall proceed to sell as many of said cattle as shall be necessary to pay off said costs and expenses and expenses of the sale, and forthwith shall pay over to the owner of said cattle or his legal representative any amount so received in excess of the legal fees and expenses of such officer. Any officer performing any of the duties enjoined in this section or in the next shall receive the same compensation therefor as is prescribed by laws for similar services, to be paid as other expenses of said board are paid by law.

Violators of law liable for damage done.

SEC. 33. Any person, such as is specified in section 29 of this title, or any officer, agent, employee, servant, or other person as is specified in section 30 of this title, violating any of the provisions hereof, shall be liable to any party injured, through such violation for any damage that may thereby arise, from the communication of Texas, splenetic, or Spanish fever, to be recovered in a civil action, and the party so injured shall have a lien for his damages on the cattle so communicating the disease, such lien to be enforced in like manner as other liens are enforced.

Butchers and slaughterhouses.

SEC. 34. Any person or persons, firm, or corporation engaged in the slaughter of live stock for sale in this Territory shall slaughter all such animals in a fixed and definite slaughterhouse or slaughter pen, to be kept by such person or persons for that purpose; and before such person, persons, firm, or corporation shall begin, enter upon, or carry on the business of slaughtering any neat or horned cattle, swine, sheep, or goats for sale, or for the sale of meat, or selling or exposing for sale the meat of such animals in the Territory of Arizona, such person, persons, firm, or corporation shall first procure from the live-stock sanitary board a license to operate such slaughtering business, and to sell or expose for sale such meat, under the conditions and upon the payment of the fees herein provided; and after procuring such license, and before engaging in such business, such person or persons shall execute upon a blank form furnished by the board a bond, with two or more good and sufficient sureties, to the Territory of Arizona, in the penal sum of one thousand dollars ($1,000), to be approved by the chairman of the board of supervisors of the county in which such business is to be carried on, conditional that such person, persons, firm, or corporation shall not slaughter or expose for sale any neat animal, or the meat thereof, without first being the legal and equitable owner thereof as well in law as in fact, and that in case such person, persons, firm, or corporation shall slaughter or sell, or expose for sale, any neat animal or the meat thereof as aforesaid shall pay therefor double the value of any such animal, the same to be recovered by action on said bond in the name of the true owner of such animal. The amount so recovered shall be paid as follows: One-half to the owner of such animal, one-fourth to the inspector or person discovering the wrongful possession or slaughtering of such animal, and the remaining one-fourth to the license and inspection fund hereinafter provided for, and on the compliance with all the provisions of this title applying to butchers.

Butcher license.

SEC. 35. The live-stock sanitary board shall grant to each and every applicant therefor, upon the payment of the fees herein provided, a license to slaughter horned and neat cattle, swine, sheep, and goats as may be set forth in such application for the term of one year from the date such license is granted. If the business is to be carried on within, or within four miles of, any town of more than five thousand inhabitants the applicant shall pay to the board the sum of one hundred and fifty dollars ($150) for a license to operate such business of slaughtering, at a fixed and definite slaughtering place; in case the business is to be carried on within, or within four miles of, any town or village of more than three thousand and less than five thousand inhabitants, the applicant shall pay one hundred and twenty dollars ($120) for such slaughtering license; in case the business is to be

carried on within, or within four miles of, any town or village of over one thousand and less than three thousand inhabitants, the applicant shall pay ninety dollars ($90) for such slaughtering license; and in all other cases thirty dollars ($30) for such slaughtering license.

License is for one place only. SEC. 36. Each and every license issued under this title shall be for one specific place of business, and the location of the place of business for which it is issued shall be stated therein.

Application in writing. SEC. 37. The applicant for such license shall make written application to the board therefor and state in his application where his slaughterhouse is or will be located during the term for which such license is issued, and he shall not, during the term for which such license is issued, slaughter any neat or horned cattle, swine, sheep, or goats at any other place than that specified in his license.

Transfer of license. *Provided*, That if for any reason, the holder of a license desires to change any such slaughtering place he shall apply to the said board to have such license transferred to cover such change. And said board shall reissue such license on application therefor without any additional charge for the unexpired term of such license.

Definition of butcher. *Provided*, That any person, firm, or corporation who shall kill more than two head of horned or neat cattle for sale or for the sale of meat in any one month, or who shall kill more than six head of hogs, sheep, or goats for sale or for the sale of meat in any one month, shall be considered butchers within the meaning of this title.

Imparting Texas fever. SEC. 38. In the trial of any person charged with a violation of any of the provisions hereof, and in the trial of any civil action to recover damages for the communication of Texas, splenetic, or Spanish fever, proof that the cattle which such person charged with driving or keeping in violation of law, or which are claimed to have communicated the said disease were brought into this Territory between the first of February and the first of December of each year in which the offense was committed or such cause of action arose, from territory within the area of which the United States Department of Agriculture from time to time has given notice that a contagious and infectious disease known as splenetic, or Southern, fever exists among cattle, shall be taken as prima facie evidence that such cattle were capable of communicating or liable to impart Texas, splenetic, or Spanish fever within the meaning of this title, and that the owner or person in charge of such cattle had full knowledge and notice thereof at the time of the commission of the alleged offense: *Provided*, That the provisions hereof shall apply to the State of California during the whole year, and shall not apply to any cattle shipped or driven from Sonora, Mexico.

Joint liability. SEC. 39. Whenever two or more persons shall, in violation of this title, at the same time, or at different times during the year, drive or cause to be driven, upon any highway, range, common, or pasture within this Territory, any cattle capable of communicating or liable to impart said fever, they shall be jointly and severally liable for all damage that may arise from the communication of such disease at any time thereafter during the same year, to any domestic, native, or acclimated cattle, that have been on the same highway, range, common, or pasture, so previously traveled over by such mentioned cattle.

Evidence of theft. SEC. 40. In the trial of any criminal suit in which the accused is charged with stealing any neat animal or animals, evidence that the accused has stolen other neat animal shall be heard if offered, provided the other offenses so follow each other, when taken in connection with the facts and circumstances pertinent to each case, as to show a purpose of engaging in and continuing the work of stealing neat cattle.

Inspectors appointed on petition. SEC. 41. The said board, on petition therefor, signed by at least twenty-five persons, each of whom are engaged in the business of owning and breeding live stock in this Territory, shall have power to and shall appoint live-stock inspectors to reside in or near each city, town, or village, or at any point where live stock is slaughtered in this Territory, who shall hold office at the will and pleasure of the board. No person or persons engaged or employed in the butchering business shall be eligible to hold the office of inspector.

Butchers must give location of slaughterhouse. SEC. 42. It shall be the duty of any person, persons, or firm, or corporation, carrying on the business of slaughtering said animals, to notify the nearest inspector appointed under this title, of the location of his or their slaughterhouse or slaughter pen, and of the time or times when such person or persons propose to slaughter any such animals, and no animal shall be slaughtered by any person until it shall have been first inspected and certified to as being the property of the one slaughtering it or causing it to be slaughtered, or that such person is authorized to slaughter. The board shall prepare these certificates in blank, and a copy of each certificate given shall be kept in a book by the inspector, which book shall at all times be open to inspection and examination of all persons wishing to inspect or examine it. Upon said animals so inspected and certified to being butchered, then the inspector shall inspect the hide, and if he shall find it to be the hide of the animal so inspected and certified to, then he shall tag the same on the left side of the neck with a tag seal to be furnished him by the board.

Inspection fee. For each animal and hide so inspected the butcher shall pay the inspector five (5) cents at the time the hide is inspected and before it is tagged, which shall be full payment for inspecting the live animal and inspecting and tagging the hide.

Inspections, and evading same. SEC. 43. A duplicate record of all inspections shall be sent to the board, and triplicate given to the butcher at such times and under such rules and regulations as the board may adopt. Any person, persons, firm, or corporation selling, removing, or secreting any hide or hides or detaching, obliterating, or defacing from or upon the hide any mark or brand before they are inspected and tagged shall be guilty of a misdemeanor and shall be punished as hereinafter provided.

Meat can not be sold before hide inspected. SEC. 44. Any ranchman, trader, or any other person not regularly engaged in carrying on the business of slaughtering neat cattle at some known and established slaughter place within four miles of some city, town, or village within the limits of this Territory who shall slaughter any neat or horned cattle for sale or for food, on their ranches or elsewhere, shall, before offering the meat for sale in any city, town, or village within the limits of this Territory, take the hide thereof to a regularly appointed inspector and shall have it inspected and tagged, immediately paying therefor five (5) cents for each hide inspected and tagged. All persons not engaged as butchers who shall at any time kill or slaughter or cause to be killed or slaughtered any cattle, either for his or their own use and consumption or for sale, shall retain or cause to be retained in his or their possession the hides taken off such animal or animals, with the earmarks attached thereto, without any alteration or disfiguration of the brands or marks on said hide or ears, for the period of twenty-one days, free to the inspection of all persons, and before shipping the same shall cause it to be inspected and tagged; and any person failing to keep the hides in the manner and for the time above mentioned, or shall refuse to any person the inspection of such hide or hides, shall be guilty of a misdemeanor, and upon conviction shall be fined in any sum not exceeding two hundred dollars ($200): *Provided*, That anyone may immediately sell or otherwise dispose of the hide of any animal as soon as it is duly inspected and tagged by an authorized inspector.

License-inspection fund. SEC. 45. All moneys received by the board for the licenses provided for in this title shall be turned over to the Territorial treasurer to be deposited in a special fund, to be known as the "License and inspection fund," and such fund shall be subject only to warrants drawn by the Territorial auditor on demand of the chairman of the live-stock sanitary board, duly countersigned by the secretary, for the payment of slaughterhouse inspectors: *Provided*, That no slaughterhouse inspector shall receive less than fifty per cent or more than ninety per cent per annum of all such license fees paid from or within his district, such payments to be made quarterly, and any and all balance remaining in each fund after paying such warrants shall, at the end of each fiscal year, be turned over to the general fund of the Territory, on demand of said board.

Untagged hides must not be purchased. SEC. 46. It shall be unlawful for any trader or other person to purchase or otherwise acquire possession of any hide of horned or neat cattle until the same shall have been inspected and tagged as required by the provisions of this title, and the possession of such untagged hide shall be considered prima facie evidence of the

commission of a misdemeanor, unless the person possessing such hide can show that the same was taken from an animal owned by him at the time of slaughter or death, or that he had written authority from the owner to remove the hide from such animal.

Butchers must send in monthly record. SEC. 47. Any person who shall set up or carry on the business of butchering or slaughtering of horned cattle or swine in this Territory shall keep a true and faithful record, in a book to be kept for that purpose, of all live stock purchased or slaughtered by him, with a description of all animals so purchased or slaughtered, including all the marks and brands of such animals, the name and residence of the person from whom purchased, and the date of such purchase; and shall at the end of each month make a true and correct copy of such record so required to be kept by this section, under oath, and deliver the same to the inspector of his district.

Penalty. Any such person, persons, firm, or corporation who fails to keep such record, or who fails or neglects to deliver a true copy of the record mentioned in this section, or who refuses to exhibit to any person demanding it the said record, is guilty of a misdemeanor, and shall be fined a sum not less than fifty dollars ($50) nor more than one hundred dollars ($100) for every day he shall have failed to comply with this section.

Untagged hides can not be transported. SEC. 48. It shall be unlawful for any person or common carrier to receive for transportation any hides until the same shall have been inspected and tagged as provided in this title.

Penalty. Any person, common carrier, or officer, agent, or servant of a common carrier who shall violate the provisions of this section shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be fined not less than one hundred dollars ($100) and not more than five hundred dollars ($500), in the discretion of the court.

Marks and brands. SEC. 49. Every person, firm, company, or corporation owning range horses, mules, asses, or neat cattle in this Territory shall have a mark or brand for them by which they shall be marked and branded; and every person owning range sheep or goats in this Territory shall have an earmark for them different from his neighbors' and as near as practicable different from any other earmark in the Territory, by which they shall be earmarked, and the same may be identified and shall be prima facie evidence of ownership, but only from and after the time herein provided; and when such mark and brand or earmark shall have been so recorded it shall be the personal property of the person causing it to be recorded, and may be sold and encumbered the same as other property, except that no range animal can be sold except by bill of sale duly made, signed, and acknowledged as deeds conveying real estate are acknowledged: *Provided*, That any earmarks or brands for sheep or goats which have heretofore been recorded in the office of the live-stock sanitary board, together with the record thereof, are hereby legalized and validated.

Records of marks and brands. SEC. 50. Said board shall record all such marks and brands as may be adopted by the owners of range animals in a book by it kept for that purpose: *Provided*, That the mark or brand so adopted has not theretofore been adopted and recorded by some other person: *And provided further*, That the mark and brand so adopted shall not conflict with the mark or brand of some other person owning range animals running in the brand and who has a prior right thereto.

Fees for recording. SEC. 51. All marks and brands not now recorded in the brand book of said board may be so recorded on the persons owning the same and having the right thereto sending to said board a facsimile copy thereof, proof that he is or they are the true and sole owner thereof, and that he is then the owner of range animals running in said brand, and inclosing therewith one dollar ($1) wherewith to pay for recording the same, and one dollar ($1) for a certificate thereof if recorded, and if not recorded, then the amount paid for the certificate shall at once be returned.

Certificate of record. SEC. 52. So soon as such brand and mark shall have been considered and passed by the board for record, then the board shall issue its certificate thereof, wherein shall be shown the name of the owner thereof, his post-office address, the place where his animals range, the date of the record thereof, and a facsimile of such brand and mark, to be signed by the

chairman of the board, attested by its secretary with the seal of the board affixed; and such certificate shall be prima facie evidence in all the courts of this Territory of the matters therein contained.

Brand book. SEC. 53. The board shall deliver to each inspector and to each county recorder's office in this Territory a true printed copy of the brand book and of all supplements thereof. Each of these shall be certified to by the chairman of the board, attested to by the secretary, and its seal affixed. The certificate shall state that it is a true, full, and correct copy of the brand book, and contains a facsimile of each and every mark and brand recorded, with its owner's name, his post-office address, and his range, opposite the mark and brand. Said printed copy of said brand book, and of all supplements thereto that are so certified to, shall be in all the courts in this Territory prima facie evidence of the truth of the matters therein contained; and the board may in its discretion deliver to any person engaged in the business of breeding range cattle certified copies of the brand book and of all the supplements thereto, on the payment to the board of such fair and reasonable price as to the board may seem just; and such books, when so certified and delivered, shall be received in evidence with like effect as to those delivered to inspectors and county recorders.

Ownership of animals. SEC. 54. The ownership of animals may be shown by the mark or brand on the animal, if marked or branded, by proof of the ownership of the mother of the animal sought to be identified and ownership of which is sought to be established, and by any person or persons who may know the animal and its owner, independent of any mark, brand, or its paternity.

Rights of prosecution. SEC. 55. In the trial of any person charged with the violation of any of the stock laws of this Territory, the prosecution shall have the right to prove, as tending to show conversion by the accused, that the animal or animals in question were branded into a brand or were marked into a mark claimed by the accused to be his brand or mark, although such brand or mark is neither of them recorded, and in all cases where any live stock, the property of a resident of a foreign country, are alleged to have been stolen and are held in this Territory, which live stock so alleged to have been stolen have either strayed or have been driven from a foreign country into this Territory, the ownership thereof may be shown by the marks or brands thereon, although such marks or brands shall not have been recorded, and in every such case the question whether any such live stock were stolen in a foreign country and were driven into this Territory, or strayed into this Territory and were then stolen in this Territory, shall be immaterial, in all cases where the allegation of the indictment is that they were stolen in the county where the indictment is found.

Words defined. SEC. 56. In all pleadings, whether civil or criminal, the words neat animal shall be held to include all kinds, ages, and sexes of the bovine species; the word horse shall be held to include all kinds, ages, and sexes of the horse species, and the word mule, all ages, kinds, and sexes of the mule kind.

Bills of sale. SEC. 57. Upon the sale, alienation, or transfer of any horses, mules, asses, or neat cattle by any person in this Territory, the actual delivery of such animals shall be accompanied by a written bill of sale from the vendor or the party selling to the party purchasing, giving the number, kind, marks, and brand of each animal sold and delivered, which bill of sale shall be signed by the party giving the same, and shall be acknowledged by him as his act and deed before some officer authorized under the laws of the Territory to take acknowledgment of deeds of conveyance; and upon the trial of any person charged with the theft, unlawful possession, handling, driving, or killing of any such animal as is mentioned in this section, under any law of this Territory, the possession of such animal by the accused, under any law of this Territory, without his having a duly written and acknowledged bill of sale therefor, such as is required by the provisions of this section, shall be prima facie evidence against the accused that such possession was illegal; and no officer acknowledging any bill of sale or other written instrument required to be acknowledged under the provisions hereof shall be authorized to exact or receive a larger fee than twenty-five (25) cents for acknowledging, certifying to, and affixing his seal to such instrument.

Vent or counter-brand. SEC. 58. Upon the demand of the purchaser, every person who sells horses, mules, asses, or neat cattle must vent or counter-brand such animals, and said vent or counter-brand must be upon the same side of the animal as the original brand. A legal vent shall be a stamp iron, and before used it must first be recorded with the county recorder of the county where

the cattle are ranged: *Provided*, That animals sold to be slaughtered or shipped out of the Territory need not be vented.

Brands not recorded. SEC. 59. Whenever any live stock branded with any brand not duly recorded as required by the provisions of this title shall be found at large upon any range in this Territory, the same shall be reported to the said board by any duly authorized inspector and detective therefor, and shall be considered as unclaimed live stock and shall be disposed of as now provided by law for the disposition of unclaimed live stock.

Written authority to handle live stock. SEC. 60. Any person, company, or corporation owning a recorded mark or brand, and being the owner or owners of animals of the horse, mule, ass, or neat-cattle kind, branded with such recorded brand, or who shall be the lawful owner of such animals having other brands, who may wish to authorize any other person or persons to gather, drive, or otherwise handle any of said animals by their mark and brand, shall furnish to such person or persons an authority in writing, containing the list of the marks and brands authorized to be handled, and authorizing the person or persons therein named to gather, drive, or otherwise handle the stock therein described, and the possession of such written authority shall be deemed sufficient to authorize the person or persons therein named to gather, drive, or otherwise handle any of such animals in the marks and brands set forth and described in the said written authority: *Provided*, That if any person, firm, company, or corporation, in giving any such written authority as is provided in this section, shall insert therein any mark or brand of which said person, firm, company, or corporation is not the lawful owner, and any animal having any such mark or brand shall be unlawfully taken, gathered, driven, or otherwise unlawfully handled by the person or persons having such written authority and by virtue thereof, then the person, firm, company, or corporation giving such written authority shall be deemed principals to the unlawful taking, gathering, driving, or handling of such animal or animals.

Sale of range cattle. SEC. 61. The owner or owners of horses, mules, asses, or neat cattle running at large upon any range in this Territory may dispose of such animals by range delivery while on the range and ungathered by the sale and delivery of the marks and brands of such animals; but in every such case the purchaser, in order to acquire title to such animals, must have his conveyance or written transfer of such animals described by marks and brands duly acknowledged by the vendor and then recorded in the office of the county recorder of the county in which such animals range, in a book kept for such purpose, and such sale or transfer shall be noted on the record of original marks and brands in the office of said board.

Unlawful branding. SEC. 62. Any person who shall mark or brand any unmarked or unbranded horse, mule, ass, or neat cattle found running at large upon any range in this Territory with a mark or brand that has not been recorded under the provisions of this title, or who, for the purpose of branding horses or cattle, uses as a brand a sash, frying pan, or any device whatsoever which can be employed or used to obliterate a brand, and every person who shall use any unrecorded brand which is an infringement upon any recorded brand, or who shall use a like brand in the same position or place recorded by another, shall be deemed guilty of larceny of said animal.

Using animals without consent. SEC. 63. Hereafter it shall be unlawful for any person to take up from any range, ranch, farm, corral, yard, or stable any horse, mule, or other animal and use the same without the consent of the owner of any such animal or of the person having the same in charge.

Taxes on live stock. SEC. 64. Live stock so branded shall be listed for assessment, and taxes assessed against the same shall be collected in the same manner as is provided for the assessment and collection of taxes upon real estate; and such assessment shall constitute a lien for taxes on all the stock in that brand: *Provided*, That if the owner of any brand shall sell any number of cattle less than the entire number under any brand before the taxes are due, such owner shall be permitted to pay taxes on the number sold proportioned to the number assessed in any such brand, and the amount shall be credited on the amount due under the assessment against any such brand.

Stock killed by locomotives. SEC. 65. In all cases where the live stock of any person is injured or killed by locomotive or cars on any portion of the line of any railroad company within this Territory unfenced by good and sufficient fence, or other barriers sufficient to turn live stock, the com-

pany or corporation running such locomotive or cars shall be liable in damages therefor to the owner of such live stock, to be recovered in any court of competent jurisdiction within this Territory, unless it be shown on the trial of any action instituted for the recovery of such damages that the owner of such live stock, his agent or servants, immediately contributed to such killing or injury. The mere straying of live stock upon unfenced portions of such railroad shall not be held upon the trial of causes brought under this title to be any evidence of contributory negligence on the part of the owner of such live stock, nor shall the grazing of the same unattended by a herder be so considered.

Liability of railroads. SEC. 66. Every railroad corporation or company operating any railroad or branch thereof within the limits of this Territory which negligently injures or kills any horse, mare, gelding, filly, jack, jennie, or mule, or any cow, heifer, bull, ox, steer, or calf, or any other domestic animal, by running any engine or engines, car or cars, over or against any such animal, shall be liable to the owner of such animal for the damages sustained by such owner by reason thereof. The killing or injury shall be prima facie evidence of negligence on the part of such corporation or company.

Driving stock on railroads. SEC. 67. If the owner or owners, or his or their duly authorized agent or agents, of any animal or animals heretofore mentioned shall drive the same upon the track of any such corporation, association, company, person, or persons, with the intent to thereby injure it or them, and such animal or animals shall be killed or injured, such owner or owners shall be liable for all injury or damage occasioned by reason of such act, and shall be punished as provided in the penal code for felony.

Railroads to keep list of stock injured. SEC. 68. Hereafter it shall be the duty of all railroads in this Territory to require all section foremen, while in their employ and service as such, to keep at the section house a specific record, upon forms furnished by said board, of all stock killed or crippled upon their respective sections of such railroad, giving age, color, sex, marks, and brands of all such stock so killed or crippled, which record shall be open and free for inspection by the public at all reasonable times.

Railroad crossings. SEC. 69. Any railroad corporation or lessee, person, company, or corporation operating any railroad in this Territory which may hereafter fence their right of way shall make crossings through their fence and over their roadbed along their right of way at least every five miles thereof, or as near thereat as may be practicable.

Width of crossings. SEC. 70. Such opening shall not be less than sixty feet in width. The said railroad company or lessee, person, corporation, or company operating any railroad shall place cattle guards and wing fences on either side of the said openings sufficient to prevent any cattle entering upon the said right of way so enclosed.

Places unfenced. SEC. 71. Such railroad company, lessee, person, or corporation operating any railroad shall leave unfenced any places wherein the said railroad runs over any trestles or bridges that are sufficiently high for cattle to go under the same.

Penalty. SEC. 72. Any railroad company, lessee, person, or corporation operating any railroad in this Territory violating any of the provisions of the seven preceding sections shall be deemed guilty of a misdemeanor, and upon conviction thereof shall, in any court of competent jurisdiction, be fined in a sum of not less than one hundred dollars ($100) and not more than three hundred dollars ($300).

Inspections must be by daylight. SEC. 73. All inspections of live stock made by inspectors shall be made in daylight, and the inspection of horses, mules, asses, and cattle shall be made, when pens will admit, by driving such animals into a pen or corral in bunches of not more than five, and held in such pen or corral until the inspector shall personally see and inspect each and every mark and brand and mark the same on his record or tally, and when he has so inspected and tallied such cattle and is satisfied as to the same he shall order them driven out and another bunch driven in such pen or corral in like manner, and so on until the entire herd is inspected, but if there are no pens convenient to the animals to be inspected, then it shall be done in such way as the inspector shall direct.

Penalty for hindering inspector. SEC. 74. Any inspector who shall inspect cattle in any other manner than that prescribed, or any owner, employee, or other person who shall oppose, obstruct, hinder, or attempt

to obstruct or hinder, by act or suggestions, such inspection as prescribed, shall be guilty of a misdemeanor, and fined not less than fifty dollars ($50) and not more than three hundred dollars ($300), or imprisonment in the county jail not more than ninety days.

General penalty. SEC. 75. Any person violating any of the provisions of this title the penalty of which is not otherwise specially provided for shall be adjudged guilty of a misdemeanor, and upon conviction thereof shall be fined in any sum not less than ten dollars ($10) nor more than three hundred dollars ($300), or be imprisoned in the county jail for not less than ten days nor more than six months, or by both such fine and imprisonment, in the discretion of the court, but nothing in this title shall be construed to repeal any existing law imposing penalties for the unlawful taking, driving, killing, branding, defacing of brands, or other unlawful handling of any of the kinds of animals mentioned herein.

Criminal cases. SEC. 76. It shall be the duty of the prosecuting attorney of the proper county to prosecute on behalf of the Territory all criminal cases arising under this title.

Attorney-general. SEC. 77. It shall be the duty of the attorney-general at all times to advise with said board whenever called on, to give opinions in writing in response to requests by the said board, its agents or employees.

Took effect September 1, 1901.

SANITARY PROTECTION OF SHEEP

Sheep inspector. SECTION 1. The board of supervisors of any county in this Territory, upon the presentation of a petition signed by not less than fifteen residents of such county, each of whom shall be the owner of not less than two thousand sheep in such county, engaged in the business of sheep breeding and wool growing in this Territory, shall appoint an inspector of sheep for such county, who shall hold his office for the term of two years and until his successor is appointed and qualified, unless sooner removed by such board of supervisors, and shall receive from such county such salary as may be agreed upon by the board of supervisors, not to exceed one hundred dollars ($100) per month.

Qualifications and bond. Such inspector of sheep shall be a resident of the county for which he is appointed, and shall be a practical sheep man. Before entering upon the discharge of his duties he shall execute a bond, payable to the Territory of Arizona, in the sum of one thousand dollars ($1,000), with at least two good and sufficient sureties, to be approved by the board of supervisors, conditioned for the faithful discharge of the duties of his office. Such inspector may appoint one or more deputies within his county, for whose official acts he and his official bond shall be responsible.

Duties. It shall be the duty of such inspector at any time, upon the written information of any citizen of his county having in charge or owning sheep, that sheep in such county owned by or in charge of any other person, giving location thereof, and infected with scabs, scabies, or other contagious or infectious disease, or upon personal knowledge of such facts, to examine such sheep without delay, and, if he shall find such sheep to be infected with any such diseases, he shall notify the owner or party in charge thereof, in writing, to doctor, dip, or cure them forthwith by the use of some standard curative medicine, and shall place such sheep in quarantine, and direct and limit the range to be occupied, and the route of travel of such sheep, until dipped and cured of such disease as directed by such inspector, and if such owner or party in charge of such sheep shall fail, neglect, or refuse to carry out the directions of such inspector, said inspector shall take such sheep into his possession at once and cure them, or cause them to be cured. He may call to his assistance such aid as may be necessary for that purpose, and the owner or owners of such sheep shall be liable to said inspector for all necessary expenses, costs, and charges incurred in curing such sheep, including a compensation of five dollars ($5) per day to such inspector or his deputy for every day or part of a day in which he shall be necessarily employed, and ten (10) cents per mile for each and every mile traveled to and from the place of quarantine or doctoring.

Infected sheep. SEC. 2. Whenever on examination of any herd or band of sheep within any county of this Territory said inspector shall find such sheep or any part of them infected by any of said diseases, he shall forthwith take

all and every necessary measure and precaution to prevent such disease from spreading, and the owner or owners of such sheep shall immediately proceed to treat such sheep for the cure of such disease, and any person who shall refuse or neglect to immediately observe the directions of such inspector as provided in this section or the preceding section of this act, shall be guilty of a misdemeanor, punished on conviction by a fine of not less than one hundred dollars ($100) and not more than two hundred and fifty dollars ($250).

Inspector may prescribe dip. SEC. 3. The inspector in charge shall be empowered to prescribe the kind of dip to be used, its strength, and all the conditions and details of the dipping, doctoring, and curing of any diseased or infected sheep, and no diseased or infected band of sheep shall be released by such inspector until they are pronounced cured and clean:

Appeal to veterinarian. *Provided*, That whenever the decision of the inspector shall be denied or disputed by the owner or party in charge of the sheep, he shall be entitled to appeal to the Territorial veterinarian, who shall examine such sheep and whose decision shall be final as to such disease or infection:

Veterinarian to act where no inspector. *Provided*, That in all counties of this Territory where no inspector is appointed, as above provided, the Territorial veterinarian shall have and exercise all the powers of sheep inspector for such county or counties, and shall receive for himself and his deputy the same fees provided for inspectors in addition to his mileage as Territorial veterinarian.

Payment of fees. SEC. 4. All legal fees, charges, and expenses of such inspector, under this act, shall be a first lien upon any such diseased or infected sheep, in whosesoever possession they may be found, for thirty days after treatment, as herein provided; and in case the owner or owners, or party in charge representing such owner or owners, in their absence, shall fail or refuse to pay any legal charges, fees, mileage, or expenses, upon the completion of such inspection or treatment, as provided in this act, such inspector may recover such fees, charges, and expenses from the owner or owners of such sheep by an action in any court of competent jurisdiction, or he may seize and hold such sheep, or any part thereof, for such payment; and if such fees, charges, or expenses are not paid within ten days after such treatment is completed, then such inspector may sell, at public or private sale, sufficient of such sheep to pay all legal fees, charges, and expenses, including the expense of such seizure and holding, and five dollars ($5) per day for his time during such seizure and holding.

Times of dipping. SEC. 5. Any band or flock of sheep infected with scab or scabies shall be dipped as often as necessary, and until they are pronounced clean by the inspector; but no sheep shall be required to be dipped, at such season of the year, or during such inclement weather, or so short a time before or after lambing, or under any such conditions or circumstances that would endanger the health or lives of such sheep, but diseased or infected sheep which can not for any reason be dipped at once must be held and run under the quarantine regulations of the inspector until such time as they may be safely dipped, and any sheep so held and run shall be so restrained and quarantined as to incur the least practicable damage to the sheep and expense of [or] hardship to the owner, and the fee of five dollars ($5) per day shall not in any case be charged by the inspector so long as the owner or party in charge shall comply with all reasonable regulations of the inspector.

Inspector must use diligence. SEC. 6. It shall be the duty of each inspector appointed as aforesaid to use diligence in ascertaining the existence of scab or scabies or other contagious or infectious disease among the sheep of his county, and to inspect from time to time all sheep within his county, and see that the spirit and intent of the law is enforced; and any inspector or deputy inspector who shall fail or neglect to faithfully perform the duties of such office shall be guilty of a misdemeanor and subject to a fine not to exceed one hundred dollars ($100).

Took effect May 1, 1901.

ARKANSAS.

AN ACT To amend the act establishing a district quarantine line in the State of Arkansas.

Be it enacted by the General Assembly of the State of Arkansas:

Time when line is open. SECTION 1. That section two of an act entitled "An act to locate and establish a district cattle quarantine line in the State of Arkansas," approved March 19, 1899, be amended to read as follows: Said line shall be open to the free and unrestricted transfer of cattle, by driving or otherwise, across said line from and after the fifteenth day of November of each year, and shall continue open until the first day of March the succeeding year, after which date it shall be unlawful to drive or transport any and all cattle across said line:

Cattle passing through exempt. *Provided*, That this act shall not interfere with the shipment of cattle by cars which are being transported across the State to other markets or places of destination outside of the State or Territory included in said quarantine district.

Repealing clause. SEC. 2. That all laws and parts of laws in conflict with this act be, and the same are hereby, repealed, and that this act shall take effect and be in force from and after its passage.

Approved February 16, 1901.

AN ACT To amend an act entitled "An act to locate and establish a district cattle quarantine line in the State of Arkansas," approved March 9, 1899.

Be it enacted by the General Assembly of the State of Arkansas:

New quarantine line. SECTION 1. That section 1 of an act to locate and establish a district cattle quarantine line in the State of Arkansas, approved March 9, 1899, be amended so as to read as follows:

"That there shall be established by the State of Arkansas a district cattle quarantine line, described as follows: Beginning at the northwest corner of Benton County and running thence south along the boundary line of this State to the southwest corner of Washington County; thence in an easterly direction following the southern boundary lines of Washington, Madison, Newton, Searcy, and Stone counties to the northwest corner of Cleburne County; thence south along the line between Cleburne and Independence counties to the southwest corner of Independence County; thence east along the southern boundary of Independence County to the west boundary of Jackson County; thence north along the line between Jackson and Independence counties to the Lawrence County line; thence east along the southern boundary of Lawrence County to the southeast corner of Lawrence County; thence north along the eastern boundary of Lawrence County to the southern boundary of Greene County; thence east along the southern boundary of Greene County to the Missouri line."

Repealing clause. SEC. 2. That all laws and parts of laws in conflict herewith be, and the same are hereby, repealed, and that this act take effect and be in force from and after its passage.

Approved March 22, 1901.

IDAHO.

AN ACT To prevent the spread of infectious or contagious diseases, providing for the disposition of animals dying therefrom, and fixing a penalty for failure to comply therewith.

Be it enacted by the Legislature of the State of Idaho:

Destruction of diseased carcasses. SECTION 1. It shall be the duty of any person or persons, company, or corporation, owning any hog, cattle, horse, or other domestic animal, which dies from any infectious or contagious disease, to cremate, or cause to be cremated, bury, or cause to be buried, at a depth of not less than three feet, the carcass of said dead animal, within twelve hours after the owner of said animal has knowledge of the death thereof.

Penalty. SEC. 2. Any person or persons, company, or corporation, violating any of the provisions of section 1 of this act shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be fined in any sum not less than twenty-five dollars ($25) nor more than three hundred dollars ($300); and for every

twelve hours after the owner of said animal has knowledge of the death thereof shall be declared a distinct and separate offense.

Carcasses on public highway. It shall be the duty of the road supervisor to remove any dead animal from the public highways whose owners are unknown, and dispose of the same in the manner provided by this act.

Repealing clause. SEC. 3. All acts and parts of acts in conflict herewith are hereby repealed.

Emergency. SEC. 4. Whereas an emergency exists, this act shall take effect and be in force from and after its passage and approval.

Approved March 11, 1901.

AN ACT Establishing quarantine against diseased sheep, prescribing the duties of the governor and State sheep inspector in relation thereto, and providing penalties for the infraction of its provisions.

Be it enacted by the Legislature of the State of Idaho:

Governor to prohibit importation. SECTION 1. Whenever the governor of the State of Idaho has reason to believe that scab or any other infectious disease of sheep has become epidemic in certain localities in any other State or Territory, or that conditions exist that render sheep likely to convey disease, he must thereupon by proclamation designate such localities and prohibit the importation from them of any sheep into the State, except under such restrictions as, after consultation with the State sheep inspector, he may deem proper.

Penalty. Any person or corporation who, after publication of such proclamation, receives in charge any such sheep from any of the prohibited districts, and transports, conveys, or drives the same to and within the limits of any of the counties of this State, is punishable by fine not exceeding one thousand dollars ($1,000) nor less than two hundred dollars ($200), and is liable for all damages that may be sustained by any person by reason of the importation or transportation of such prohibited sheep.

Inspectors to enforce quarantine laws. SEC. 2. Whenever the proclamation of the governor, issued as hereinbefore provided, shall prohibit the driving or importation of sheep into this State from another State or Territory, or subdivisions thereof, it shall be the duty of the State sheep inspector, or any of his deputies, to drive or transport said sheep so coming into this State, in violation of said proclamation, back across the State line from which they came, using all necessary force in so doing: *Provided*, That the State sheep inspector, or his deputies, may employ such assistance as may be necessary for the enforcement of the provisions of this act; and the costs of such deportation shall be a lien upon said sheep: *Provided*, That if the fine and costs in this act provided shall not be immediately paid, the deputy sheep inspector shall retain a sufficient number of said sheep to pay such fine and costs, which sheep shall be sold to pay the same, by the deputy sheep inspector, in the same manner as provided by law for the sale of personal property to satisfy a judgment; and for such services the deputy sheep inspector shall receive and retain such fees as are allowed sheriffs for like services, to be taxed as costs.

Refusal to assist. SEC. 3. Any person failing or refusing to assist such deputy sheep inspector, as in the preceding section provided, shall be punished as in section 6517 of the Revised Statutes of Idaho (1887) made and provided.

Emergency. SEC. 4. Whereas an emergency exists therefor, this act shall be in force and effect from and after its passage and approval.

Approved, March 1, 1901.

AN ACT To suppress contagious and infectious diseases of sheep, to create the office of sheep inspector and deputy State sheep inspectors, to provide for the appointment of the same, and to fix their compensation, making the doing of certain acts a crime and providing for the punishment of the same, and for other purposes, and repealing an act entitled "An act to suppress contagious and infectious diseases of sheep, to create the office of State sheep inspector and of deputy sheep inspectors, to provide for the appointment of the same and fix their compensation, making the doing of certain acts a crime and providing for the punishment of the same, and for other purposes," approved February 25, 1899.

Be it enacted by the Legislature of the State of Idaho:

Governor to appoint sheep inspector. SECTION 1. The office of sheep inspector for the State of Idaho is hereby created. It shall be the duty of the governor, within twenty-five days from and after the passage

of this act, to appoint some suitable, capable, and discreet person and practical sheep grower to fill said office.

Salary and duties of inspector. SEC. 2. The said sheep inspector shall receive as full compensation for his services a salary of twelve hundred dollars ($1,200) per annum, to be paid as the salary and fees of other State officers are paid. It shall be the duty of the State sheep inspector to have general supervision over his deputies appointed under the provisions of this act, and to aid, counsel, and advise with such deputies, and generally to enforce the provisions of this act. The said sheep inspector shall have the same power within the entire State as the deputies appointed by him have in their respective districts, and where the services of the State sheep inspector are demanded in a county or district other than that in which he resides, to settle differences between sheep men and any deputy, it shall be the duty of said State sheep inspector to go and adjust such differences, and the said party or parties demanding such services shall pay the actual traveling expenses of said State sheep inspector.

Term of office and bond. SEC. 3. Said State sheep inspector shall hold his office for the term of two years, and until his successor is appointed and qualified, unless sooner removed by the governor. Before entering upon the discharge of his duties as such officer he shall file an official bond in the sum of five thousand dollars ($5,000), conditioned for the faithful performance of the duties of his office, in form and manner as other official bonds of State officers.

Deputy inspectors. SEC. 4. Such State sheep inspector shall have power, and it shall be his duty, to divide each county or counties into districts and to appoint for such districts one or more deputy inspectors, as in his judgment may seem necessary. Such deputies shall hold office until their successors are appointed and qualified, unless sooner removed by the State sheep inspector. They shall be practical sheep men, who, before entering into the duties of their office, shall take an oath of office as required of county officers, and shall give a bond to the State of Idaho in the penal sum of five thousand dollars ($5,000), conditioned for the faithful performance of the duties of such deputy sheep inspector, such bond to be approved by the State sheep inpector and be placed on file in his office. Such deputy shall be subject to removal by the State sheep inspector when, in his judgment, it shall seem necessary.

"Inspection lines." SEC. 5. It shall be the further duty of the State sheep inspector, with the assistance of the deputies appointed by him in the several districts, to create what shall be known as "inspection lines" in each county or district where it shall be deemed necessary between the summer and winter ranges, and shall cause a notice, containing a careful description of said "inspection line" in each district, to be published for three weeks in some newspaper published in said district, and upon the last publication thereof due notice of the location of such "inspection line" shall be deemed to have been given. The expense of such publication shall be a charge against the county where such notice is given, payable as other charges: *Provided*, That this section shall not be so construed as to prohibit other stock crossing said inspection lines and occupying the range inclosed by said lines.

Sheep must not cross line without inspection. SEC. 6. It shall be unlawful for any person, persons, company, or corporation owning, controlling, or managing any band or herd of sheep [to drive or herd] or cause to be driven or herded across such line going to or returning from the summer range without first having his or their sheep inspected, and obtaining the sheep inspector's certificate showing such sheep to be sound and free from scab.

Penalty. Any person, persons, company, or corporation violating this section shall be guilty of a misdemeanor, and shall be, upon conviction, punished by fine of two hundred and fifty dollars ($250), and such fine shall constitute a first lien upon said sheep so driven or herded, and shall be collected as provided for in section 14 of this act.

Inspectors may administer oaths. SEC. 7. The State sheep inspector and his deputies, appointed under this act, shall have the power to administer oaths so far as the same may be necessary in the proper performance of their duties, and any person who shall, contrary to said oath, state as true any material thing which he knows to be false is guilty of perjury.

Examinations and certificates. SEC. 8. It shall be the duty of at least one deputy inspector in each county or district, to be designated by the State sheep inspector, to personally examine all sheep and bands of

sheep in his county or district between the first day of March and the first day of June of each year, and again between the first day of September and the first day of November of each year; and the State sheep inspector may, at any time he deems necessary, order an inspection in any county or district; and to the owners and persons in charge of herds found to be clean, the deputy shall issue a certificate stating such fact, which certificate shall permit such herds to pass into and through any and all counties in this State so long as they shall remain clean and free from disease; such deputy is required to examine any band or bands of sheep at any time that he may be called upon to do so at the request of one or more sheep growers, in writing, stating that such sheep are affected or infected with some infectious or contagious disease, and that there is imminent and immediate danger of the spread of such disease: *Provided*, That upon examination such sheep are found to be clean, the person or persons making such complaint shall pay the expenses of such examination, which may be recovered in a civil action therefor; but in case such inspector, upon making such examination, finds said sheep diseased, he shall forthwith issue his order quarantining said sheep, and they shall be dealt with as provided in section 9 hereof.

Diseased sheep to be quarantined and dipped.

SEC. 9. Whenever, upon an examination of any bands or herds of sheep kept or herded in any county of the State of Idaho, the deputy sheep inspector of such county or district thereof shall find such sheep, or any portion of them, affected or infected with the scab or scabies, or any other infectious or contagious disease, the entire band or herd shall be considered as infected and treated as such, and he shall immediately quarantine the same and forthwith notify the owner or person in charge of said sheep, in writing, to dip said sheep twice for said disease within the period of thirty days from said notice; the first dipping not to exceed fifteen days from the receipt of said notice and the second dipping to be within the period of from eight or twelve days from the first dipping, and also during such period to keep such sheep free from contact with other sheep by such means as he shall specify until after the second dipping: *Provided*, That in case the owner or controller of any sheep which, on account of their condition, or by reason of the inclemency of the weather, shall, in the opinion of such owner or controller, be unfit or unsafe to dip, such deputy inspector may authorize such owner or controller to place such sheep in a corral, field, or feed yard, where said sheep shall be kept from contact with other sheep until such time as they are in condition to dip. Such owner or controller shall be responsible for any and all damages which may be incurred by reason of such sheep coming in contact with sound sheep. Any person or persons so allowed to keep his sheep in such corral, field, or feed yard, who shall wilfully or knowingly take, or permit to be taken, any such sheep from such corral, field, or feed yard, except as the same shall, by the deputy inspector, be directed or permitted to take to the dip works, shall, upon conviction thereof, be punished by a fine of not less than five hundred dollars ($500) nor more than two thousand dollars ($2,000), or by imprisonment not to exceed six months, or by both said fine and imprisonment.

Superintendence and expenses of dipping.

SEC. 10. Such deputy sheep inspector, or competent persons appointed by him, shall superintend all dipping provided for in this act, and shall have full and complete power to enforce and designate the strength, heat, and length of time such sheep shall be in the bath, and all expenses incurred in so doing, including a compensation of five dollars ($5) for every day or part of a day in which said deputy sheep inspector or persons appointed by him may be engaged in dipping said sheep, shall become and is hereby made a first lien upon said sheep, and, if the same is not paid within ten days, he shall sell so many of said sheep as may be necessary to realize sufficient money to pay said sum due him, together with the costs and charges of the sale, including five dollars ($5) per day for each day he holds said sheep. Such sale shall be made and conducted in the same manner as sales of personal property on execution out of the district court.

Penalty for failure to dip.

SEC. 11. The owner or owners or controller of any sheep, or the deputy inspector or persons appointed by him, who shall fail to dip said sheep, as required by the provisions of this act, shall be guilty of a misdemeanor, and upon conviction thereof shall be punished by a fine of not less than three hundred dollars ($300) nor more than five hundred dollars ($500), or by imprisonment in the county jail for a period of not less than two months nor more than six months, or by both such fine and imprisonment.

Dipping at lambing time.

SEC. 12. No person, persons, company, corporation, or association within the State of Idaho shall be required to dip his or their band or bands of ewes, or any part of them, within ten days of the commencing of lambing and fifty days thereafter, of any year, but such sheep

when found to be infected shall be held in quarantine and separate and apart from sound sheep; and the owner, owners, or controllers thereof shall be responsible for all damages as stated in this act, to be recovered as herein provided for.

Hand-dressing in quarantine. SEC. 13. It shall also be the duty of said deputy sheep inspector to require the owner, owners, or controllers of sheep, while held in quarantine during the period mentioned in the above section, to spot or hand dress all sheep in their band or bands that show any scab or any contagious or infectious disease with some reliable medicine; and such deputy sheep inspector shall have the power to enforce such hand-dressing or spotting during the period above referred to the same as he has power to enforce dipping at any other period of the year, as provided in this act.

Owners failing to dip. SEC. 14. Should any owner or person in charge of any sheep found to be infected upon examination by the deputy sheep inspector fail or refuse to dip said sheep, or should do so in an improper manner, it shall be the duty of said deputy sheep inspector to seize said sheep and to dip the same. And when the same shall have been dipped he shall notify the owner or person in charge of the amount of the costs, charges, and expenses due from the same.

If such owner or person in charge shall neglect or refuse for the period of ten days after receiving said notice to pay the same together with all further costs, charges, and expenses of holding said sheep, it shall be the duty of the said deputy to sell so many of said sheep as may be necessary to pay the same and all costs and expenses of said sale. Such sale shall be made and conducted as sales of personal property on execution out of district court.

Salary of deputy inspectors. SEC. 15. The deputy sheep inspectors appointed in the several counties or districts, as provided in this act, shall receive five [dollars] ($5) per day for every day or part of a day spent in the performance of his duty, to be paid by the owner or owners of the sheep examined, and to be enforced as a lien against the sheep so examined, as provided in section 14 of this act.

Inspection and charges on entering State. SEC. 16. Any person, persons, company, corporation, or association, or any agent or employé of any person, persons, company, corporation, or association, who shall drive or herd, or cause to be driven or herded, or shall bring or cause to be brought into the State of Idaho, any sheep from any other State, shall immediately, upon crossing the State line of Idaho, notify the deputy sheep inspector of the county or district where said sheep crossed the State line, and before he shall proceed further than two miles from the said State line into the State of Idaho, he shall make an application, in writing, to such deputy inspector for the inspection of said sheep. Said application must be served on the deputy of that county or district in person or left at his place of residence or by registered letter. Said notice must state the time and place said sheep crossed the State line, and the locality from whence they came, and must give the name and residence of the owner of said sheep and the name of the herder or controller, the number of sheep and the brands of said sheep, and for each band of sheep of 3,000 head or less, the party making the application shall deposit with the deputy inspector the sum of ten dollars ($10) to cover the cost of inspection of said sheep.

Any deputy sheep inspector on receiving such notice shall at once proceed to inspect said sheep as set forth in the application, and if, upon inspection, said deputy inspector shall deem it necessary or advisable so to do to prevent or avoid infection therefrom, he shall cause said sheep to be quarantined at some place not more than two miles from the said State line where said sheep entered the State of Idaho, for a period of not more than ninety days, and if deemed necessary by him, said inspector shall cause said sheep to be dipped at least twice, at the option of the said deputy inspector, before they are released from such quarantine.

Any person, persons, company, corporation, or association, or his or their agent or employé, who shall ship by railroad into this State from any other State, any sheep, shall, before such sheep are unloaded at any point or place within this State, notify personally the deputy inspector of the district within which it is intended to unload such sheep, and thereupon said deputy inspector shall forthwith proceed to inspect, quarantine, and dip said sheep as in this section heretofore provided.

Any person violating any of the provisions of this section shall be guilty of a misdemeanor and shall be fined, upon conviction thereof, in a sum not less than five hundred dollars ($500) and not exceeding five thousand dollars ($5,000), which fine shall be a lien upon said sheep, and shall be enforced by proper proceedings in any court of competent jurisdiction.

SEC. 17. It shall be the duty of the deputy sheep inspector, upon receipt of such notice of sheep having crossed the State line in his district, at once to inspect the same, as provided in the preceding section, and said sheep must remain within two miles of said State line until so inspected.

Any person or persons violating any of the provisions of this section shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be punished by a fine of not less than five hundred dollars ($500) nor more than five thousand dollars ($5,000).

When sheep are brought into this State, in violation of section 16 of this act, it shall be the duty of the deputy sheep inspector of the district or county wherein said sheep may be, immediately to seize the same and hold them, and file a complaint in a court of competent jurisdiction, charging the owner or person in charge of said sheep with a violation hereof, and, upon the conviction of the defendant in said action, the said deputy shall (unless all fines, costs, and charges be immediately paid) sell, in the same manner as sales of personal property on execution out of the district court, so many of said sheep as may be necessary to pay the costs and charges of making such sale, including the compensation due him, together with the fine imposed in such action. And a certified copy of the judgment in such action shall be his sufficient warrant for doing the same.

Penalty for importing infected sheep.

SEC. 18. It is unlawful for any person, persons, company, corporation, or association to drive, or cause to be driven, bring or cause to be brought, into the State of Idaho from any other State any sheep infected with scab or any contagious or infectious disease. Every person so offending shall be deemed guilty of a misdemeanor, and, upon conviction thereof, shall be punished by a fine of not less than five hundred dollars ($500) and not exceeding five thousand dollars ($5,000), or by imprisonment in the county jail for not less than six months nor more than one year, or by both such fine and imprisonment, for each and every herd or band of such sheep consisting of three thousand head or less, so brought into this State. And said sheep shall be seized, held, and sold to satisfy the costs of seizure and the payment of any fine that shall be imposed by any court of competent jurisdiction in the manner provided for in section 17 hereof.

Traveling permit for infected sheep.

SEC. 19. Any person, persons, company, or corporation or association within the State desiring to move his or their sheep, which are not sound, or are infected by scab or other infectious or contagious disease, shall first obtain from the deputy sheep inspector a traveling permit. Such permit shall only be granted for the purpose of removing said sheep to the nearest suitable point where there are available dipping works, or where they can be constructed, at which place said sheep shall be dipped. Such sheep shall travel to said point over a route designated by the deputy sheep inspector.

Herders to be notified.

The person or persons moving said sheep shall first notify all parties herding sheep along or over said route that the infected sheep have to travel of the time they will pass over said route. And any person, persons, company, corporation, or association injured or damaged by reason of the moving of said sheep shall be entitled to recover from the person, persons, company, corporation, or association moving the same, in civil action, the amount of damage, direct and consequential: *Provided, however,* No party shall be entitled to recover damages who voluntarily herd, or cause to be herded, any sheep on quarantined ground. Said sheep so voluntarily herded shall be considered as scabby without inspection, and shall be treated as provided in section 9 hereof.

Penalty.

Any person or persons violating any of the provisions of this section shall be guilty of a misdemeanor, and, upon conviction thereof, shall be punished by a fine of not less than five hundred dollars ($500) nor more than one thousand dollars ($1,000) or by imprisonment in the county jail for not less than two months nor more than six months, or by both such fine and imprisonment.

Inspectors' liability.

SEC. 20. Any deputy sheep inspector granting a permit allowing sheep to travel, without at the time having first examined the sheep, shall be guilty of a misdemeanor, and upon conviction thereof shall be punished by a fine of not less than three hundred dollars ($300) and not more than five hundred dollars ($500).

Owners must report disease within fifteen days.

SEC. 21. Any person or persons owning or having under their control sheep or bands of sheep which have become infected with the scab or other infectious or contagious disease for a period of fifteen days without reporting the fact to

the deputy sheep inspector of such county or district thereof where such sheep are situate, in writing, shall be guilty of a misdemeanor, and shall, upon conviction thereof, be punished by a fine of not less than five hundred dollars ($500) nor more than one thousand dollars ($1,000) or by imprisonment in the county jail for not less than two months nor more than six months, or by both such fine and imprisonment. Such fine, if not immediately paid, shall be collected, together with all costs and charges, by seizure and sale of the sheep, as provided in section 17 hereof.

Placing sheep in another's corral.

SEC. 22. It shall be unlawful for any person, persons, company, corporation, or association to drive or cause to be driven any sheep into any sheep corral the property of another without first having obtained in writing the consent of the owner or person having control or custody of such sheep corral.

Penalty.

Any person, persons, company, corporation, or association violating any of the provisions of this section shall be guilty of a misdemeanor, and, upon conviction thereof, shall be punished by fine of not less than two hundred dollars ($200) nor more than five hundred dollars ($500) or imprisonment in the county jail for not less than six months nor more than one year, or by both such fine and imprisonment.

Definition of owner.

SEC. 23. In any action or proceeding, civil or criminal, arising under this act, all persons having any interest in sheep or controlling the same, and concerning which said action or proceeding is had, shall be deemed the owner of said sheep, and shall be liable, jointly and severally, for such violation.

Herder must give information to inspector.

Any herder or shepherd or other person in charge of sheep may be sworn to give any deputy sheep inspector any and all information as to the condition of the sheep in his charge, to the best of his knowledge, on being requested so to do by the deputy, and upon refusing to do so shall be guilty of a misdemeanor, and, upon conviction thereof, shall be punished by a fine of not less than one hundred dollars ($100) nor more than three hundred dollars ($300) or by imprisonment in the county jail for not less than two months nor more than six months, or by both such fine and imprisonment.

Marks and brands and deputies' reports.

SEC. 24. It shall be the duty of each deputy sheep inspector appointed under this act to keep a book in which he shall record as complete a description as practicable of the marks and brands with which each person in his county or district marks or brands his sheep, and the owners of sheep shall report, in writing, to such deputy sheep inspector their marks and brands for the purpose of aiding such deputy sheep inspector to make up and keep such records. Such deputy sheep inspectors are also required to keep a book in which they shall record the name of all persons prosecuted for violation of this act, together with a description of the particular offense charged against him or them, the name of the court in which the prosecution was had, and the result of such prosecution, giving the amount of fines, where fines are imposed. And on the first day of January of each year each deputy sheep inspector appointed under the provisions of this act shall make a report to the State sheep inspector; at the end of each inspection period shall state the condition in his county or district and the number of cases of scab, which report shall contain a true and correct copy of his record as contained in the books required by him to be kept under the provisions of this act, which report shall be placed on file in the office of the State sheep inspector. Said deputy inspector shall also keep a record showing the names of the owners or controllers of and the number and brands of all sheep inspected and quarantined by him under the provisions of section 16 of this act, together with the cause of quarantine, when the same shall have been imposed, and the length of time such quarantine was continued.

Common carriers must have certificate of inspection.

SEC. 25. It shall be unlawful for any person, persons, company, corporation, or association owning, controlling, or managing a ferryboat, toll bridge, car, steamboat, or other things used for transportation in the State of Idaho to allow any sheep destined to points within the State to be loaded thereon unless the party in charge of said sheep shall first produce a certificate from a deputy sheep inspector appointed under this act that said sheep are free from scab, scabies, and other infectious or contagious disease: *Provided*, That this shall in no case apply to sheep being shipped out of the State. Any violation of this section shall be deemed a misdemeanor and punishable by a fine of not less than five hundred dollars ($500) nor more than one thousand dollars ($1,000).

Stray sheep to be reported. SEC. 26. If any person, persons, company, or corporation in driving or herding any sheep should get into his or their herd any stray sheep, he or they must, within five days after discovering the fact, notify the owner thereof; and if the owner is unknown he or they shall forthwith notify the deputy sheep inspector of such county, giving the number of such sheep and the brands of each.

Penalty. Any person, persons, company, corporation, or association violating the provisions of this section shall be guilty of a misdemeanor, and, upon conviction thereof, shall be fined not less than one hundred dollars ($100) nor more than three hundred dollars ($300).

Deputies have power to arrest. SEC. 27. All deputy sheep inspectors are hereby given the power, and it is made their duty, to arrest and bring before a justice of the peace, or other court having jurisdiction of the same, all persons found violating any of the provisions of this act, where a complaint shall be filed by such deputy sheep inspector, either upon his own knowledge or upon information of such violation; whereupon a hearing shall be had as in other like criminal cases; and such deputy sheep inspectors are hereby vested with the same authority to arrest, and to require aid, in the execution of their said office, as sheriffs and their deputies of the several counties of the State: *Provided*, That the provisions of this act requiring the deputy sheep inspector to prosecute for a violation of the provisions hereof shall not be construed so as to prevent such prosecution from being commenced and prosecuted by other persons as criminal actions are commenced and prosecuted in other cases.

Deputies' fee for prosecution. The deputy sheep inspectors, as full compensation for their services in prosecutions under this act, shall be allowed five dollars ($5) per day, and same shall be assessed as costs in the case against the defendant.

Law of 1899 repealed. SEC. 28. An act entitled "An act to suppress contagious and infectious disease of sheep; to create the office of State sheep inspector and of deputy sheep inspectors, to provide for the appointment of the same and fix their compensation; making the doing of certain acts a crime and providing for the punishment of the same, and for other purposes," approved February 25, 1899, is hereby repealed.

Repealing clause. SEC. 29. All acts and parts of acts in conflict with this act are hereby repealed.

Emergency. SEC. 30. Whereas an emergency exists therefor, this act shall be in force and take effect from and after its passage.

Approved March 7, 1901.

INDIANA.

AN ACT Entitled an act to establish the office of State veterinarian of Indiana, to provide for the appointment of the State veterinarian by the governor, and to provide for the control and suppression of dangerous, contagious, and infectious diseases among domestic animals, making an appropriation for expenses of the same, and for the repeal of all laws or parts of laws conflicting herewith.

Be it enacted by the General Assembly of the State of Indiana:

State veterinarian, qualifications, etc. SECTION 1. That an office is hereby established, to be known as the State veterinarian of Indiana. The office of State veterinarian of Indiana shall be filled by appointment by the governor; the person so appointed shall be a competent and qualified veterinarian of large experience, and shall be a graduate of a reputable veterinary college in the United States, Canada, or Europe. The term of office of the State veterinarian shall be four years, but he may be removed for cause.

Duties of State veterinarian. SEC. 2. That it shall be the duty of the State veterinarian to protect the health of the domestic animals of the State, and to determine the most efficient and practical means for the prevention, suppression, control, and eradication of dangerous, contagious, and infectious diseases, and to investigate the cause, nature, means of prevention, and treatment of such diseases as he may deem advisable, and for these purposes he is hereby authorized and empowered to establish, maintain, enforce, and regulate such quarantine and other measures relating to the movements and care of animals and their products, the disinfection of suspected localities and articles, and the destruction of such ani-

mals and property as he may deem necessary, and to adopt from time to time all such regulations as may be necessary and proper for the carrying out of the purposes of this act: *Provided, however,* That in the case of any slowly contagious disease, only suspected or diseased animals shall be quarantined.

Appraisal of condemned animals. SEC. 3. That when it shall be deemed necessary to kill any animal or animals, or to destroy any property to prevent further spread of disease, the State veterinarian or his agent may adjust the claim with the owner or his agent: *Provided,* That the amount to be paid is less than twenty-five dollars ($25); if the claim exceed twenty-five dollars ($25), or an agreement can not be made with the owner or claimant for the amount thereof, three appraisers, who shall be freeholders in the county, shall be appointed, one by the State veterinarian or his agent, one by the owner or claimant, and a third by the two appointed, as aforesaid, who shall under oath or affirmation appraise the animal, animals, or property, taking into consideration their or its actual value at the time of appraisement, and such appraisement shall be paid in the same manner as other expenses under this act are provided for: *Provided,* That under such appraisement not more than twenty-five dollars ($25) shall be paid for any infected animal: *And provided further,* The right to indemnity does not exist and the payment of such must not be made in the following cases:

For animals belonging to the United States;

For animals belonging to the State;

For animals brought into the State contrary to the rules and regulations of the State veterinarian;

For animals found to be diseased, or that are destroyed because they have been exposed to disease before or at the time of their arrival in the State;

For an animal which was previously affected by any other disease which from its nature and development was incurable and necessarily fatal;

For an animal which the owner knowingly or wittingly purchased affected with disease, or from a place where contagious disease was known to exist.

Dipping of sheep. SEC. 4. That all sheep consigned to or passing through stock yards shall be dipped before leaving, if intended for any other purposes than immediate slaughter in the State, the time of dipping, the manner of dipping, and kind of dip used to be subject to the approval of the State veterinarian: *Provided,* That in the winter and at such times as the dipping of sheep would be hazardous to their health, the sheep may be withdrawn upon permit from the State veterinarian, which permit shall be issued upon the written agreement of the owner that the sheep will remain in his possession, and that he will dip at such future time and in such manner as the State veterinarian may direct. That all sheep found affected with scabies shall be dipped at such time and in such manner and with such dip as the State veterinarian shall direct, and at the expense of the owner.

Power to enter premises, etc. SEC. 5. That the State veterinarian or his authorized agent shall at all times have the right to enter any premises, farms, fields, pens, abattoirs, slaughterhouses, buildings, cars, or vessels where any domestic animals are at the time quartered, or wherever the carcass of any one may be, for the purpose of examining it in any way that may be deemed necessary to determine whether they are or were the subjects of any contagious or infectious disease.

Cooperation with United States Government. SEC. 6. That the State veterinarian may accept in behalf of the State the rules and regulations prepared and adopted by the Department of Agriculture of the United States for the suppression of any contagious diseases among domestic animals, and shall cooperate with the authorities of the United States in the enforcement of such rules and regulations.

Powers of United States inspectors. SEC. 7. That the inspectors of the Bureau of Animal Industry shall have the same right of inspection, quarantine, and condemnation of animals affected with any contagious or infectious disease or suspected to be so affected, or that may have been exposed to any such disease, and for such purposes they may enter upon any ground or premises, they may call upon the sheriffs, constables, and other peace officers to assist them in the discharge of their duties, and such sheriffs, constables, or peace officers shall assist such inspectors when so requested, and such inspectors shall have the same power and protection as peace officers when in the discharge of their duties: *Provided,* That this State shall not be liable for any damages or expenses caused or made by such inspectors.

Governor may prohibit importation. SEC. 8. That whenever the governor has good reasons to believe that any disease has become epidemic in another State or Territory, and that the importation of animals from such State or Territory would be prejudicial to the health of the domestic animals of this State, he must, by proclamation, designate such locality or localities and prohibit the importation therefrom of any live stock of the kind diseased, except under such rules and regulations as the State veterinarian shall prescribe.

Owners to report disease. SEC. 9. That any person knowing or suspecting a dangerous, contagious, or infectious disease to exist among live stock shall report the same to the local health officer, who shall, within twenty-four hours, report the same to the State veterinarian. The State veterinarian or his agent shall visit the locality and make an examination of the suspected stock and prescribe and enforce such rules and regulations as may be necessary: *Provided*, That an owner of an animal or animals affected with a dangerous or contagious disease shall report the same within forty-eight hours after knowing such to exist.

Inspection of dairies, etc. SEC. 10. The State veterinarian shall, as far as possible, investigate such diseases of animals as are communicable to man, and such conditions of dairies as the State board of health may request.

General penalty. SEC. 11. Any person or persons, any company or corporation, wilfully violating any of the provisions of this act, or any regulation or order of the State veterinarian or agent appointed by him shall be deemed guilty of misdemeanor, and shall, upon conviction, be punished by a fine not exceeding one hundred dollars ($100), or by imprisonment not exceeding thirty days, or both, at the discretion of the court.

Assistance and supplies. SEC. 12. That the State veterinarian is hereby empowered to appoint and employ such assistants or agents, and to purchase supplies and materials as may be necessary in carrying out the provisions of this act: *Provided*, That the sum expended for supplies and materials shall not exceed two hundred dollars ($200) in any one year. That the State veterinarian or his duly appointed agents are empowered to administer oaths or affirmations, that they may make such examinations into the conditions of the live stock of the State in relation to contagious and infectious diseases, including milk supplies of cities, towns, and villages, as may seem necessary, and to take proper measures to protect such milk supplies from contamination. The decision of the State veterinarian in all matters pertaining to diseases of domestic animals and his orders as to their disposition shall be final. He may call upon any peace officer for assistance in the discharge of his duties, and such peace officer shall give assistance.

To publish rules and regulations. SEC. 13. That the State veterinarian shall, from time to time, publish the rules and regulations pertaining to the control and suppression of dangerous, contagious, and infectious diseases of domestic animals, and such regulations shall have the force and effect of laws of the State of Indiana. He shall make an annual report to the governor of all work done and a statement of expenditures.

Salaries and accounts. SEC. 14. That the governor, auditor of state, and treasurer of state shall constitute a committee to determine the salary of the State veterinarian and to audit his accounts, and upon the certification by the governor to the auditor of State the amount due the State veterinarian and assistants for salary and expenses the auditor shall draw his warrant upon the treasurer for said amount in favor of the State veterinarian and assistants, respectively, payable out of the funds hereinafter appropriated; and upon further certification by the governor to the auditor of State of the amount due any person for an animal or animals condemned or property destroyed, the auditor shall draw his warrant upon the treasurer for the amount so certified, payable out of the funds hereinafter appropriated: *Provided*, That said committee shall not receive additional compensation for said work: *And further provided*, That the salary of the State veterinarian shall not exceed twelve hundred dollars ($1,200) and necessary traveling expenses in one year, and that not more than eight hundred dollars ($800) shall be allowed for assistants.

Appropriation. SEC. 15. That the sum of three thousand dollars ($3,000) is hereby appropriated annually for carrying out the provisions of this act.

Law of 1889 repealed. SEC. 16. That an act entitled "An act to provide for a live-stock sanitary commission and a State veterinarian, and to prescribe their powers and duties, and to prevent and suppress contagious and

infectious diseases among the live stock of the State, and to declare an emergency," approved March 9, 1889, and all other laws and parts of laws in conflict therewith, be and the same are hereby repealed.

Approved, March 6, 1901.

KANSAS.

AN ACT Supplementary to and amendatory of chapter 139 and chapter 142 of the General Statutes of Kansas, 1897, and to repeal sections 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, and 14, and amend sections 15 and 16 of said chapter 139 of the General Statutes of Kansas, 1897, and to amend sections 2, 13, 14, and 19 of chapter 142 of the General Statutes of Kansas, 1897, and to enlarge the powers and duties of the live-stock sanitary commission, to provide for the inspection of cattle and fix fees therefor, to provide for the appointment of live-stock inspectors and clerk by the live-stock sanitary commission, and fix compensation of persons so appointed, and to provide punishment for the violation of the provisions hereof.

Be it enacted by the Legislature of the State of Kansas:

SECTION 1. That sections 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, and 14 of chapter 139 of the General Statutes of Kansas, 1897, be and the same are hereby repealed.

Quarantine regulations. SEC. 2. That section 15 of chapter 139 of General Statutes of Kansas, 1897, be and hereby is amended to read as follows:

"SEC. 15. Whenever the live-stock sanitary commission shall determine that certain cattle or other animals within the State are capable of communicating or liable to impart Texas, splenic, or Spanish, fever, or any other infectious or contagious disease, they shall issue their order to the sheriff or any constable of the county in which such cattle or other animals are found, commanding him to take and keep such cattle or other animals in his custody, subject to such quarantine regulations as they may prescribe, until such time as shall be prescribed by the commission, on which date they shall direct such officer to deliver said cattle or other animals to their owner or owners or his or their agent.

Costs of quarantine. "Before any cattle or other animals shall be delivered as aforesaid there shall be paid to said live-stock sanitary commission all costs and expenses of taking and detaining and holding said cattle or other animals; and in case such costs and expenses are not so paid at the time fixed by said commission, the said officer shall advertise, in the same manner as is by law provided in cases of sale of personal property on execution, that he will sell such cattle or other animals, or such portion thereof as may be necessary to pay such costs and expenses, together with the costs and expenses of such sale; and at the time and place so advertised he shall proceed to sell as many of said cattle or other animals as may be necessary to pay for such costs and expenses and the expenses of such sale, and shall forthwith pay over to the live-stock sanitary commission any amount so received in excess of the legal fees and expenses of such officer; and any officer performing any of the duties enjoined in this section or any other section of this act shall receive the same compensation therefor as is prescribed by law for similar services, and in case such fees can not be collected by the sale of such stock they shall be paid by the county in which such stock was held."

Shipping diseased cattle. SEC. 3. That section 16 of chapter 139 of the General Statutes of Kansas, 1897, be and the same is hereby amended to read as follows:

"SEC. 16. Any person or persons who shall drive, ship, or transport, or cause to be driven, shipped, or transported, into or through any county in this State any cattle liable to or capable of communicating Texas, splenic, or Spanish, fever to any domestic cattle of this State shall be liable to any person or persons injured thereby for all damages that they may sustain by reason of the communication of said diseases of Texas, splenic, or Spanish, fever, to be recovered in a civil action in any court of competent jurisdiction, and the parties so injured shall have a lien for such damages on the cattle communicating the disease of Texas, splenic, or Spanish, fever."

Duties of secretary of commission. SEC. 4. That section 2 of chapter 142 of the General Statutes of Kansas, 1897, be and the same hereby is amended to read as follows:

"SEC. 2. Said commissioners shall elect one of their members chairman, one of their members secretary, and it shall be the duty of the secretary to make and keep a record of all of the official acts and proceedings of the commission and its members

and report the same to the governor annually, and oftener, if required, for publication. Such annual report shall include an itemized statement of the expenditures and disposition of all funds coming into the possession of the commission, and of the amount of compensation received by said commission, and all expenses incurred by said commission in the performance of their duties, and a statement of all animals directed to be killed, together with the appraised value thereof; and for such purposes the commission may appoint and employ one clerk, at a salary not exceeding six hundred dollars ($600) per annum."

Owners to report disease. SEC. 5. That section 13 of chapter 142 of the General Statutes of Kansas, 1897, be and the same hereby is amended to read as follows:

"SEC. 13. It shall be the duty of any owner or person in charge of any domestic animal or animals, who discovers, supposes, or has reason to believe that any domestic animal owned by him or in his charge or keeping is affected with Texas, splenic, or Spanish, fever, or any other contagious or infectious disease, to immediately report such fact, belief, or supposition to the live-stock sanitary commission or some member thereof and to the sheriff and county clerk of the county in which such domestic animal is kept or found; and it shall be the duty of any person who discovers the existence of any contagious or infectious disease among the domestic animals of any person to report the same at once to the sheriff and county clerk of the county in which such domestic animals are kept or found."

Duties of sheriff. SEC. 6. That section 14 of chapter 142 of the General Statutes of Kansas, 1897, be and the same hereby is amended to read as follows:

"SEC. 14. The sheriff to whom the existence of any Texas, splenic, or Spanish, fever or any other contagious or infectious disease of domestic animals is reported shall forthwith proceed to the place where such domestic animal is and examine the same, and forthwith report the result of such examination to the live-stock sanitary commission or any member thereof, and said sheriff shall prescribe such temporary quarantine regulations as will prevent the spread of the disease, contagion, or infection until the live-stock sanitary commission can provide and order suitable quarantine rules and regulations; and any such sheriff who shall take or detain such cattle or other live stock under the provisions of this act shall not be liable to the owner or owners of such cattle or other live stock for any damages by reason of such taking or detention, or by reason of the performance of any other duties enjoined by law."

Owners liable. SEC. 7. That section 19, chapter 142, of the General Statutes of Kansas, 1897, be and the same is hereby amended to read as follows:

"SEC. 19. Any person who shall have in his possession any domestic animals affected with any contagious or infectious disease, knowing such animal to be so affected, or after having received notice that such animal is so affected, who shall permit such animal to run at large or who shall keep such animal where other domestic animals not affected with or previously exposed to such disease, contagion, or infection, or who shall sell, ship, drive, trade, or give away such diseased and infected animal or animals which have been exposed to such infection and contagion, or who shall move or drive any domestic animal in violation of rules, regulation, direction, or order establishing and regulating quarantine, shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be fined in any sum not less than one hundred ($100) or more than five hundred dollars ($500) for each of such diseased or exposed domestic animals which he shall permit to run at large or keep, or sell, ship, drive, or trade, or give away in violation of the provisions of this act: *Provided*, That any owner of any domestic animal which has been affected with or exposed to any contagious or infectious disease may dispose of the same after they [he] obtain[s] from the live-stock sanitary commission a bill of health for such animal."

Cattle carrying ticks. SEC. 8. All cattle being at or brought from any point south of the south line of the State of Kansas, and carrying *Boophilus bovis*, or Southern ticks, are deemed to be infected with and capable of communicating Texas, splenic, or Spanish, fever, and such cattle shall not be shipped or transported into the State of Kansas except for immediate slaughter, and then only under such rules and regulations as may be prescribed by the live-stock sanitary commission.

Southern cattle to be inspected. SEC. 9. It shall be unlawful for any person or persons to bring, drive, or transport any cattle into any county of the State of Kansas, except for immediate slaughter, as provided in the preceding section, from any point south of the south line of Kansas, without

having first caused such animal or animals to be inspected and passed under certificate of health by the live-stock sanitary commission of this State, or some inspector thereof; and any person or persons violating the provisions of this section shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be punished by a fine of not less than fifty ($50) nor more than one thousand dollars ($1,000), or by imprisonment in the county jail not less than thirty days nor more than one year, or by both such fine and imprisonment.

Inspection stations. SEC. 10. The live-stock sanitary commission is hereby authorized and empowered to establish stations along the south line of the State of Kansas for the inspection and admission of cattle into the State, as may be necessary to afford reasonable convenience for the inspection and admission of such cattle as are healthy and, being free from infection and contagion, may be entitled to admission under the laws of Kansas; and such commission shall appoint competent inspectors, and station them at such points and places as the commission may deem necessary for the accommodation of the business interests and protection of the live stock in the State of Kansas, by the prompt and thorough inspection of cattle brought into this State: *Provided*, That the number of inspectors so appointed shall not at any time exceed seven.

Duties of inspectors. SEC. 11. It shall be the duty of such inspectors so appointed by the live-stock sanitary commission to promptly examine and inspect all cattle presented for admission into this State from any point south of the south line of the State of Kansas, and if, upon such inspection, the same shall be found free from any infection or contagion, and clean of and not carry any *Boophilus bovis*, or Southern ticks, he shall make out and deliver to the owner or person in charge of said cattle a certificate that the same have been inspected and found to be healthy and free from infection and contagion.

Inspection fees. SEC. 12. Any owner or owners of cattle required to be inspected under the provisions of the preceding section shall not be entitled to have such inspection made until he shall have paid or tendered to the live-stock sanitary commission, or some member thereof, or some person appointed and authorized to make inspection for said commission, an inspection fee of two (2) cents for each head so to be inspected, which fee, when collected by the commission, commissioner, or inspector, as aforesaid, shall be paid into the State treasury of the State of Kansas, and become a fund for the payment of salaries of such inspection: *Provided*, That the provisions of this section shall not apply to shipments made to points not within the State of Kansas, nor to points within the State of Kansas, if such shipments are for immediate slaughter.

Salary of inspectors. SEC. 13. The inspectors hereinbefore provided shall receive as full compensation for their services the sum of one hundred dollars ($100) per month, to be paid out of the funds in the State treasury derived from the fees collected as provided in the last preceding section; but if from any cause said fund shall at any time be insufficient to pay such salaries, then the same shall be paid as the salaries of other State officers.

SEC. 14. That sections 15 and 16, of chapter 139 of the General Statutes of Kansas, 1897, and sections 2, 13, 14, and 19, of chapter 142 of the General Statutes of Kansas, 1897, be, and the same are hereby, repealed.

SEC. 15. This act to take effect and be enforced from and after its publication in the official State paper.

Approved February 28, 1901.
Published in official State paper March 15, 1901.

MASSACHUSETTS.

AN ACT Relative to infectious diseases among domestic animals.

Be it enacted, etc., as follows:

Law of 1899 amended. Section eight of chapter four hundred and eight of the acts of the year eighteen hundred and ninety-nine is hereby amended by inserting after the word "killed," in the twenty-sixth line, the words: "or if such animal has been inspected and proof satisfactory to said board

has been furnished to it, by certificate or otherwise, of the freedom of such animal from disease," so as to read as follows:

Animals condemned. SEC. 8. When the board of cattle commissioners or any of its members or agents, by examination of a case of contagious disease among domestic animals, is convinced that the public good requires it, the board, commissioner, or agent shall cause such animal or animals to be securely isolated, or shall cause it or them to be killed without appraisal or payment. Such order for killing shall be issued in writing by the board or any of its members, and may be directed to an inspector or other person, and shall contain such direction as to the examination and disposal of the carcass, and the cleansing and disinfecting of the premises where such animal was condemned, as the board or commissioner shall deem expedient.

Payment to owner. "A reasonable sum may be paid out of the treasury of the Commonwealth for the expense of such killing and burial. If it shall subsequently appear, upon postmortem examination or otherwise, that such animal was free from the disease for which it was condemned, a reasonable sum therefor shall be paid to the owner by the Commonwealth. Whenever any cattle condemned as afflicted with the disease of tuberculosis are killed under the provisions of this section, the full value thereof at the time of condemnation, not exceeding the sum of forty dollars ($40) for any one animal, shall be paid to the owner out of the treasury of the Commonwealth if such animal has been owned within the State six months continuously prior to its being killed, or if such animal has been inspected and proof satisfactory to said board has been furnished to it, by certificate or otherwise, of the freedom of such animal from disease: *Provided, however*, That such person shall not have, prior thereto, in the judgment of the board, by willful act or neglect, contributed to the spread of tuberculosis; but such decision on the part of the commissioners shall not deprive the owner of the right of arbitration as hereinafter provided."

Approved April 4, 1901.

MINNESOTA.

AN ACT To amend chapter 233 of the the General Laws of 1897 entitled "An act to prevent the spread of contagious and infectious diseases among domestic animals in this State."

Be it enacted by the Legislature of the State of Minnesota:

Regulations for quarantine, etc. SECTION 1. That section one of chapter two hundred and thirty-three of the General Laws of the State of Minnesota for the year 1897, entitled "An act to prevent the spread of contagious and infectious diseases among domestic animals in this State," be, and the same is hereby, amended to read as follows:

"SECTION 1. Authority is hereby given to the State board of health, and to the several local boards of health of the towns, villages, and cities of this State, to take all steps they may severally deem necessary to control, suppress, and eradicate any and all contagious and infectious diseases among any of the domestic animals in this State, and to that end said board are hereby severally empowered, within their respective jurisdictions, to quarantine any domestic animal which is infected with any such disease, or which has been exposed to infection therefrom; to kill any animal so infected, and whenever deemed necessary by the State board of health, to kill any animal which has been exposed to the infection of any such disease; to regulate or prohibit the arrival in or departure from this State, and the towns, villages, and cities thereof, of any such exposed or infected animal, and, at the cost of the owner thereof, to detain any domestic animal found in violation of any such regulation or prohibition; to adopt all such rules and regulations as may be by such several boards deemed necessary or expedient to enforce the authority hereby given; and said State board of health is hereby expressly given authority to regulate or prohibit the shipment into this State of any domestic animal which, in the judgment of said board, may endanger the public health: *Provided*, That no board of health shall by any rule or regulation thereof prohibit the sale, disposal, or removal of any domestic animal by any person or persons, or from any place, when said animal has no contagious disease, or has not been exposed to any contagious disease, and that the fact that animals are upon the same premises with others having a contagious disease shall not of itself be construed as evidence of exposure to such contagious disease as is had by said other animals."

SEC. 2. This act shall take effect and be in force from and after its passage.

Approved April 9, 1901.

AN ACT To amend sections 5 and 12 of chapter 233 of the laws of 1897, entitled "An act to prevent the spread of contagious and infectious diseases among domestic animals in this State."

Be it enacted by the Legislature of the State of Minnesota:

Rights of owners when animals ordered killed.

SECTION 1. That section five of chapter two hundred and thirty-three of the laws of 1897 be, and the same is hereby, amended so as to read as follows:

"SEC. 5. Whenever a domestic animal has been adjudged to be infected with a contagious or infectious disease, and has been ordered killed by the State board of health, or by a local board of health, the owner or keeper of such animal shall be notified thereof, and within twenty-four hours thereafter he may file a protest with the board of health which has ordered such animal killed against the killing thereof, and shall therein state, under oath, that to the best of his belief such animal is not infected with any contagious or infectious disease; whereupon, said animal being killed notwithstanding such protest, a postmortem examination thereof shall be made by experts, appointed one by the board of health—one by the owner, and one by the two already appointed—and if upon such examination said animal shall be found to have been entirely free from contagious or infectious disease there shall be appointed three competent and disinterested men—one by the board of health, one by the owner of the animal killed, and the third by the two already appointed—to appraise it at its cash value immediately before it was killed, and the amount of such appraisal shall be paid to the owner of such animal, one-fifth part thereof by the town, village, or city where the animal was kept, and four-fifths thereof by the State.

Appraisals.

"All appraisements made under this act shall be in writing and signed by the appraisers and certified to by the local board of health and the State board of health, respectively, to the governor of the State and to the treasurer of the several towns, villages, and cities wherein the animals appraised were kept. Upon the filing of any such appraisement it shall be the duty of the State board of health with which the same is filed to make a certificate, under their hands, of the number of days served by the appraisers in making their appraisement, and upon the filing of such certificate with the State treasurer, such treasurer shall pay each of said appraisers one dollar ($1) per day for his services as such appraiser.

Payment for animals killed.

"Whenever any such animal has been adjudged infected with the disease of tuberculosis, and has been ordered killed by the State board of health or by a local board of health, and is killed in accordance therewith, the value of such animal, less the value of the carcass thereof, shall be determined as hereinbefore specified, and shall be paid for to the owner as follows: One-third of the value thereof shall be paid by the State, one-third thereof by the town, village, or city where the animal is kept, and the remaining one-third thereof shall be borne by the owner of such animal.

"Payment in such cases shall be made by the State and such town, village, or city, as hereinbefore set forth: *Provided, however*, That in no case shall the appraised value of such animal exceed the sum of forty dollars ($40), nor shall any payment be made for the killing of any such animal infected with said disease of tuberculosis unless such animal was owned and kept in good faith in this State for at least the space of one year next prior to the killing thereof.

"Whenever any such animal which has not been adjudged to be infected is killed by order of said board, but not by the owner or keeper thereof, a postmortem examination thereof shall be made by experts, appointed as aforesaid, and if found to have been entirely free from any infectious disease the value of such animal shall be determined and paid for as hereinbefore specified. Except as in this section expressly provided, no compensation shall be paid for any animal killed by virtue of any authority given by this act."

Appropriation.

SEC. 2. That section twelve of chapter two hundred and thirty-three of the laws of 1897 be, and the same is hereby, amended so as to read as follows:

"SEC. 12. The sum of nineteen thousand dollars ($19,000), or so much thereof as is necessary, is hereby annually appropriated for the payment of the expenses that may be incurred by the State in enforcing this act, such expense to be approved by the State board of health and by the governor."

SEC. 3. This act shall take effect and be in force from and after its passage.

Approved April 13, 1901.

MONTANA

AN ACT Amending section 3018 of Article V, Chapter V, Part III, Title VII, of the Political Code, relating to the appointment and compensation of deputy veterinary surgeons.

Be it enacted by the Legislative Assembly of the State of Montana:

SECTION 1. That section 3018 of Article V, Chapter V, Part III, Title VII, of the Political Code be, and the same is hereby, amended so as to read as follows:

"SEC. 3018. The veterinary surgeon has power to appoint from time to time one deputy at any time he can not personally attend to all the duties required by his office, at a salary not to exceed five dollars ($5) per day for each day actually employed, together with his actual and necessary traveling expenses, to be paid out of the stock indemnity fund."

SEC. 2. This act shall be in effect from and after its passage and approval.

Approved March 16, 1901.

AN ACT To prevent the slaughter and sale of big-jawed cattle and cattle having any other disease, and prescribing punishment therefor.

Be it enacted by the Legislative Assembly of the State of Montana:

SECTION 1. Any person who shall slaughter, sell, or offer for sale for the purpose of food any cattle having big jaw or any other disease shall be guilty of a misdemeanor, and upon conviction thereof shall be punishable by a fine of not exceeding five hundred dollars ($500) or be imprisoned in the county jail not exceeding one year, or by both such fine and imprisonment.

SEC. 2. All acts and parts of acts in conflict herewith are hereby repealed.

SEC. 3. This act shall be in full force and effect from and after its passage and approval by the governor.

Approved March 9, 1901.

NEBRASKA.

AN ACT To amend sections 60, 61, 61a, and 61b, and to repeal section 61c, chapter 4, article 1, Compiled Statutes of Nebraska, 1899, relative to swine diseases, and to repeal said original sections 60, 61, 61a, 61b, and 61c, chapter 4, article 1, Compiled Statutes of Nebraska, 1899.

Be it enacted by the Legislature of the State of Nebraska:

SECTION 1. That section 60 of chapter 4, article 1, of Compiled Statutes of Nebraska, 1899, be, and hereby is, amended to read as follows:

Disposal of diseased carcasses. "SEC. 60. The owner of any swine which die from disease or sickness shall have the carcasses of the same buried within twenty-four hours after death, at least eighteen inches deep, or have the carcasses burned on the premises where the animal died. Any person violating this section shall be guilty of a misdemeanor, and upon conviction thereof be fined in any sum not to exceed ten dollars ($10)."

SEC. 2. That section 61 of chapter 4, article 1, of Compiled Statutes of Nebraska, 1899, be, and is hereby, amended to read as follows:

Dealing in diseased carcasses. "SEC. 61. If any person owning, or assuming to own or control, swine, any of which have died from disease or sickness, or shall dispose of the carcasses of said animals for any purpose whatever; or shall render into lard or oil the said carcasses; or if any person who shall buy or receive the carcasses of said dead animals, shall be guilty of a misdemeanor, and upon conviction thereof shall be fined in any sum not less than twenty-five dollars ($25) or more than one hundred dollars ($100), or be imprisoned in the county jail not to exceed three months."

SEC. 3. That section 61a of chapter 4, article 1, Compiled Statutes of Nebraska, be, and is hereby, amended to read as follows:

Removal of diseased carcasses. "SEC. 61a. If any person shall remove or convey along any public highway, road, alley, or street the carcass of any swine that has died from sickness or disease, shall be guilty of a

misdemeanor, and upon conviction thereof shall be fined not less than twenty-five dollars ($25) or more than one hundred dollars ($100), or be imprisoned in the county jail not exceeding three months."

SEC. 4. That section 61b of chapter 4, article 1, Compiled Statutes of Nebraska, be, and is hereby, amended to read as follows:

Possession of diseased carcasses. "SEC. 61b. If any person or company engaged in the business of manufacturing soap, or rendering lard or oil, shall receive or have in their possession the carcass of any swine which has died from sickness or disease, shall be guilty of a misdemeanor, and upon conviction shall be fined not less than twenty-five dollars ($25) or more than three hundred dollars ($300), or be confined in the county jail not to exceed three months."

Law of 1899 repealed. SEC. 5. That sections 60, 61, 61a, 61b, and 61c, chapter 4, article 1, Compiled Statutes of Nebraska, 1899, as the same now exist, be, and the same are hereby, repealed.

Approved March 30, 1901.

AN ACT Concerning the care of and to prevent the spread of contagious and infectious diseases among domestic animals, and to provide for the appointment of a State veterinarian and assistant, to regulate their power and duties, to provide for the compensation, and to repeal sections 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, and 27 of article 11, chapter 4, Compiled Statutes of Nebraska, 1895, entitled "State veterinarian—live-stock agents."

Be it enacted by the Legislature of the State of Nebraska:

State veterinarian and deputy. SEC. 1. The governor is hereby made the State veterinarian, and he is required within thirty days from the approval of this act and every two years thereafter to appoint one deputy State veterinarian, who shall hold office for a term of two years and until his successor shall have qualified, and who may be removed by the governor at any time for cause.

Assistant veterinarians. SEC. 2. The governor shall appoint such assistant veterinarians as he shall deem necessary for the carrying out of the provisions of this act. The said deputy State veterinarian and assistant veterinarians shall each be a graduate in good standing of a college of veterinary surgery which shall be recognized as such by the American Veterinary Medical Association. They shall have all the powers of the State veterinarian while acting for him in the performance of his duties. They shall be under the direction of the State veterinarian, and shall be required to make reports to him of their official acts at such times as he may deem necessary. The deputy State veterinarian shall receive a salary of $1,500 per annum and his actual traveling expenses, provided same shall not exceed $500 per annum. The assistant veterinarians shall receive, to be paid out of the general fund of the State, five dollars ($5) per day and their actual traveling expenses incurred and paid by them while actually engaged in the discharge of their official duties, provided same shall not exceed $200 per annum.

Bond of deputy. SEC. 3. Before entering upon his duties the deputy State veterinarian shall take and subscribe an oath to faithfully discharge the duties of the office, and shall execute a bond to the State of Nebraska in the sum of five thousand dollars ($5,000), with good and sufficient security, conditional upon the faithful performance of the duties of the office, which bond and security shall be approved by the governor. The said bond, together with the oath of office, shall be deposited in the office of the secretary of State.

Special report by deputy. SEC. 4. The deputy State veterinarian shall make a continuous scientific study, investigation, and research of all contagious diseases of domestic animals, and the causes, preventives, and cures thereof, and report the results of his study and investigation to the governor, giving in plain, ordinary language the symptoms by which any such disease may be identified, how liable to be introduced and spread, the causes and conditions to which it may be attributed, and the introduction of any such diseases and the sanitary and other measures best calculated to prevent the germination and spread of any such contagious or infectious diseases among live stock, together with the best known treatment and remedies, in time for publication in the several reports required by law, and perform such other service as may be required by law or directed by the governor.

Duties of deputy. SEC. 5. It shall be the duty of the deputy State veterinary surgeon, provided for in the first section of this act, to protect the health of the domestic animals of the State from all contagious and infectious diseases of a malignant character, and for this purpose he is hereby authorized and

empowered to establish, maintain, and enforce such quarantine, sanitary, and other regulations as he may deem necessary, subject to the approval of the governor. It shall be the duty of the deputy State veterinarian, upon receipt by him of reliable information of the existence among domestic animals of the State of any malignant diseases, to go at once to the place where such disease is alleged to exist and make a careful examination of the animals believed to be affected with any such disease, and ascertain, if possible, what, if any, disease exists among the stock reported to be affected, and establish quarantine, sanitary, and police regulations necessary to circumscribe and exterminate such disease; also to list and describe the domestic animals affected with such disease, and those that have been exposed thereto and included within the infected district or premises so defined and quarantined, with such reasonable certainty as would lead to their identification, and for that purpose he may, in his discretion, cause live stock so included within the quarantine lines established to be marked or branded in such manner as may be designated, and no domestic animals liable to become infected with the disease, or capable of communicating the same, shall be permitted to enter or leave the district, premises, or grounds so quarantined, except by the authority of the deputy State veterinarian. The deputy State veterinary surgeon shall also from time to time give and enforce such directions and prescribe such rules and regulations as to separating, modes of handling, treating, feeding, and care of such diseased and exposed animals as he shall deem necessary to prevent two classes of animals from coming in contact with each other and perfectly isolate from other domestic animals which have not been exposed thereto, and which are susceptible of becoming infected with the disease, and the said veterinarian or his agents are hereby authorized and empowered to enter upon any grounds or premises to carry out the provisions of this act.

Destroying infected animals. SEC. 6. When, in the opinion of the deputy State veterinarian, it shall be necessary, to prevent the further spread of any contagious or infectious disease among the live stock of the State, to destroy animals infected with, or which have been exposed to, any such disease, he shall determine what animals shall be killed or quarantined, and, when killed, the carcasses disposed of as, in his judgment, will best protect the health of the domestic animals of the locality.

Labor and supplies for deputy. SEC. 7. The deputy State veterinarian provided for in this act shall have power to employ at the expense of the State such persons, and purchase such supplies and material, as may be necessary to carry into effect all orders by him given as hereinbefore provided: *Provided*, That no labor shall be employed, nor labor, material, or supplies purchased, by the deputy State veterinarian, except such labor and material as may be necessary to carry into effect the experimentation, quarantine, and other regulations.

Owners to report outbreaks. SEC. 8. It shall be the duty of any owner or person in charge of any domestic animals who discovers, suspects, or has reason to believe that any of his domestic animals or domestic animals in his charge are affected with any contagious or infectious disease to report such fact, belief, or suspicion to the deputy State veterinarian; and it shall be the duty of any person who discovers the existence of any contagious or infectious disease among the domestic animals of another to report the same at once to the deputy State veterinarian.

Importing infected animals. SEC. 9. Any person who shall knowingly bring into this State any domestic animal which is affected with any contagious or infectious disease shall be deemed guilty of a misdemeanor, and upon conviction shall be fined in any sum not less than one hundred dollars ($100) nor more than two thousand dollars ($2,000).

Owners must allow examination. SEC. 10. Any person who owns or is in possession of live stock which is suspected or reported to be affected with any infectious or contagious disease who shall refuse to allow the deputy State veterinarian or any authorized officer or officers, in any examination of, or in any attempt to examine, such stock, shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be fined in any sum not less than fifty dollars ($50) nor more than two hundred dollars ($200).

Allowing infected animals at large. SEC. 11. Any person who shall have in his possession any domestic animal affected with any contagious or infectious disease, knowing such animal to be so affected, or after having received notice that such animal is affected, who shall permit such animal to run at large, or who shall keep such animal where other domestic animals not affected or previously exposed to such disease may be exposed to its contagion or infection, or who shall sell, ship, drive, trade, or give away such diseased animal

or animals which have been exposed to such infection or contagion, or who shall move or drive away any domestic animal in violation of any direction, rule, or order establishing and regulating quarantine, shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be fined in any sum not less than fifty dollars ($50) nor more than two hundred dollars ($200) for each of such diseased or exposed animals which he shall permit to run at large, or keep, or drive, trade, or give away in violation of the provisions of this act: *Provided*, That any owner of domestic animals which have been affected with or exposed to any contagious or infectious disease may dispose of the same after having obtained from the State veterinarian a bill of health for such animal.

Importation may be prohibited. SEC. 12. Whenever the governor of the State shall have good reason to believe that any dangerous, contagious, or infectious disease has been epizootic in certain localities in other States or Territories or countries, or that there are conditions which render domestic animals from such infected districts liable to convey such disease, he shall by proclamation prohibit the transportation of any live stock of the kind diseased into the State, except under such rules and regulations as may from time to time be prescribed by the State veterinarian, with approval of the governor.

Deputy may call on county officers. SEC. 13. The deputy State veterinarian shall have power to call upon any sheriff, deputy sheriff, or constable to execute his orders, and such officers shall obey the orders of the deputy State veterinarian, and the officers performing such duties as provided for by the act shall receive compensation therefor, [as] prescribed by law for like services, to be paid as other expenses are paid, and any officer may arrest without a warrant and take before any magistrate of the county and hold until a warrant can be issued any person found violating the provisions of this act, and such officer shall immediately notify the county attorney of such arrest, and he shall prosecute the person offending according to the law.

General penalty. SEC. 14. Except as otherwise provided in this act, any person who shall violate, disregard, or evade, or attempt to violate, disregard, or evade any of the provisions of this act, or who shall violate, disregard, or evade any of the rules, regulations, orders, or directions of the deputy State veterinarian, establishing and governing quarantine, shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be fined in any sum not less than fifty dollars ($50) nor more than two hundred dollars ($200).

Deputy may administer oaths. SEC. 15. For the purpose of this act the deputy State veterinarian is hereby authorized to administer oaths and affirmations.

Cooperation with the Government. SEC. 16. That the deputy State veterinarian be authorized and directed to cooperate with the Secretary of Agriculture of the United States, or with any officer or authority of the General Government, in the suppression and extirpation of any and all contagious diseases among domestic animals and in the enforcement and execution of any and all acts of Congress to prevent the importation or exportation of diseased cattle and the spread of infectious or contagious diseases among domestic animals.

Office accommodation. SEC. 17. It shall be the duty of the board of public lands and buildings to provide for a suitable office for the said deputy State veterinarian and his assistants in the capitol building at Lincoln.

Repealing clause. SEC. 18. That sections 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, and 27, article 11, chapter 4, Compiled Statutes of Nebraska, entitled "State veterinarian—live stock agents," be, and the same are hereby, repealed.

Approved, March 30, 1901.

AN ACT To amend section 75 and section 78 of the criminal code of the State of Nebraska, and to repeal said original sections.

Be it enacted by the Legislature of the State of Nebraska:

SECTION 1. That section seventy-five of the Criminal Code of the State of Nebraska be amended so as to read as follows:

Disposing of infected sheep. "SEC. 75. Any person, being the owner of sheep or having the same in charge, who shall turn out or suffer any sheep having any contagious disease, knowing the same to be so diseased, to run at large upon any common, highway, or enclosed ground, or who

shall sell any such sheep, knowing the same to be diseased, without fully disclosing the fact to the purchaser, shall be punished by a fine of not less than twenty dollars ($20) and not more than one hundred dollars ($100), or be imprisoned in the jail of the county not exceeding three months, in the discretion of the court: *Provided, however*, This section shall not be so construed as to prevent any person owning such diseased sheep from driving them along any public highway."

SEC. 2. That section seventy-eight of the Criminal Code of the State of Nebraska be amended so as to read as follows:

Wrongful taking of stock. "SEC. 78. If any person shall wrongfully take any horse, mare, gelding, foal, or filly, ass, or mule from the stable, lot, or pasture of another or from a hitching rack, or any other place as aforesaid, having been lawfully placed, without the consent of the owner, with intent to injure, set at large, or wrongfully use the animal so taken, such person shall be fined in any sum not exceeding one hundred dollars ($100) or be imprisoned in the county jail not exceeding three months, in the discretion of the court; and shall also be liable to the party injured in double the amount of damages sustained."

Repealing clause. SEC. 3. That sections seventy-five and seventy-eight of the Criminal Code of the State of Nebraska as heretofore existing be, and the same are hereby, repealed: *Provided, however*, That such repeal shall not be construed to apply to any offenses committed prior to the taking effect of this act, nor shall the same affect any convictions or prosecutions under either of said original sections.

Emergency clause. SEC. 4. Whereas an emergency exists, this act shall be in force and take effect after its passage and approval.

Approved, March 29, 1901

NEW JERSEY.

A further supplement to the act entitled "An act concerning contagious and infectious diseases among animals and to repeal certain acts relating thereto," approved May 4, 1886.

Be it enacted by the Senate and General Assembly of the State of New Jersey:

1. The fifth section of the act entitled "A further supplement to the act entitled 'An act concerning contagious and infectious diseases among animals and to repeal certain acts relating thereto,' approved May fourth, eighteen hundred and eighty-six," which further supplement was approved March twenty-eighth, eighteen hundred and ninety-five, and which said section five was amended by the one hundred and forty-eighth chapter of the laws of the year eighteen hundred and ninety-eight, be, and the same is hereby, amended to read as follows:

Increase of appropriation. "5. There may be appropriated to the State tuberculosis commission the sum of fifteen thousand dollars ($15,000) for defraying its expenses and for the payment of the proportion of the appraised value of slaughtered animals under this act, all which payments shall be made and expenses defrayed by the treasurer of this State upon the warrant of the State comptroller: *Provided*, That no payments shall be made pursuant to this act until the amount thereof shall have been included in the annual appropriation bill."

2. This act shall take effect immediately.

Approved, March 20, 1901.

NEVADA.

AN ACT To repeal an act entitled "An act providing for the appointment of a State live stock inspector, defining his duties, and fixing his compensation," which became a law March 22, 1899.

The people of the State of Nevada, represented in Senate and Assembly, do enact as follows:

Law of 1899 repealed. SECTION 1. The act of the legislature of the State of Nevada entitled "An act providing for the appointment of a State live stock inspector, defining his duties, and fixing his compensation," which became a law March 22, 1899, is hereby repealed.

Approved, March 12, 1901

AN ACT To amend section 1 of an act entitled "An act to prevent the dissemination of contagious diseases among sheep, to provide for the appointment of sheep inspectors in the several counties of this State, and to define their duties and compensation," approved February 23, 1893.

The people of the State of Nevada, represented in Senate and Assembly, do enact as follows:

Section 1 of said act is hereby amended so as to read as follows:

Sheep inspectors. "SECTION 1. It is hereby made the duty of the several boards of county commissioners in this State, at their first regular meeting in April, nineteen hundred and one, and annually thereafter, to appoint an inspector of sheep for each of the counties of this State, who shall reside in the county for which he is appointed. Each inspector so appointed, before entering upon the duties of his office, shall take his oath of office, and give an undertaking to the people of the State of Nevada, for the use of the respective counties thereof, with two or more sureties, to be approved by the board of county commissioners, conditioned for the faithful performance of his duties, and in such sum as the county commissioners of the several counties may deem sufficient for the faithful performance of the duties of his office and the enforcement of the requirements of this act."

Approved, March 14, 1901.

AN ACT Supplemental to an act entitled "An act to amend an act entitled 'An act to prevent the dissemination of contagious diseases among sheep, to provide for the appointment of sheep inspectors in the several counties of this State, and to define their duties and compensation,' approved February 23, 1893," approved March 6, 1899.

The people of the State of Nevada, represented in Senate and Assembly, do enact as follows:

Inspection fees. SECTION 1. The inspector of sheep in any county of this State where sheep are inspected shall collect the fees for such inspection in two annual installments; the first installment to be paid prior to the thirtieth day of June, and the second installment to be paid prior to the thirty-first day of December of each year.

Compulsory dipping. SEC. 2. It is hereby made compulsory on the part of any person or persons owning or controlling sheep in this State, between the first day of July and the first day of December in each year, where scab is visible, to dip the infected sheep twice at intervals of from ten to fourteen days.

Bringing sheep into the State. SEC. 3. Any person or persons owning or controlling sheep, and driving or bringing them into this State from any State shall, without delay, on entering this State, notify the nearest sheep inspector of their presence, with sheep, within this State.

Powers of inspectors. SEC. 4. The sheep inspectors of the several counties of this State are hereby authorized, empowered, and instructed that, on the neglect or refusal of any person or persons owning or controlling sheep to comply with the provisions of this act in respect to the dipping of infected sheep, to dip, or cause to be dipped, said infected sheep, the expenses of which shall be a charge against the band of sheep so infected, and unless the claim or demand is otherwise liquidated, the sheep inspector shall sell to the highest bidder a sufficient number of sheep from out the infected band to satisfy the claim.

Approved March 21, 1901.

NEW MEXICO.

AN ACT Relating to the licensing of dogs.

Be it enacted by the Legislative Assembly of the Territory of New Mexico:

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SECTION 3. It shall be unlawful for any person to keep any dog known to be vicious and liable to attack and injure human beings, unless such dog is securely kept so as to prevent injury to any person; and it shall be unlawful to keep any dog which may have shown any symptom of madness or rabies.

SEC. 4. It shall be the duty of all persons who may be the owner or keeper of any such dogs, the keeping of which is declared to be unlawful, to cause such dog to be killed, and any failure to comply with this provision of this section after knowledge by the owner or keeper of the fact, which rendered such keeping unlawful, shall

subject such owner or keeper to a fine of ten dollars ($10) and costs, and each day's failure to comply with the law may be held a separate offense.

* * * * * * *

SEC. 7. All of said municipal corporations are authorized to provide for the enforcement of this act by ordinance.

SEC. 8. All acts or parts of acts conflicting with this act are hereby repealed, and this act shall be in force and effect from and after its passage.

Approved March 21, 1901.

NEW YORK.

AN ACT To amend the agricultural law relative to diseases of domestic animals; to repeal article 4 of the public health law and incorporate in its stead certain provisions of the agricultural law relating to the public health, and making an appropriation to carry out the provisions of this act

The people of the State of New York represented in Senate and Assembly do enact as follows:

SECTION 1. Article four of chapter three hundred and thirty-eight of the laws of eighteen hundred and ninety-three, entitled "An act in relation to agriculture, constituting articles one, two, three, four, and five of chapter thirty-three of the general laws," as amended by chapter four hundred ninety-one of the laws of eighteen hundred ninety-eight, and chapter one hundred eighteen of the laws of nineteen hundred, is hereby amended to read as follows:

"ARTICLE IV.—*Diseases of domestic animals.*

Suppression of infectious and contagious disease.

"SEC. 60. Whenever any infectious or contagious disease affecting domestic animals shall exist, be brought into, or break out in this State, the commissioner of agriculture shall take measures to promptly suppress the same and to prevent such disease from spreading. The local boards of health shall notify the commissioner of the existence of infectious or contagious disease affecting domestic animals in the districts subject to their jurisdiction.

Commissioner to issue notice.

"SEC. 61. He shall issue and publish a notice stating that a specified infectious or contagious disease exists in any designated county or other geographical district of the State, and warning all persons to seclude in the premises where they may be at the time all animals within such county or district that are of a kind susceptible to contract such disease, and ordering all persons to take such precaution against the spreading of the disease as the nature thereof may in his judgment render necessary or expedient, and which he may specify in such notice. Such notice shall be published in such newspapers and be posted in such manner as the commissioner may designate and as in his judgment are most likely to give notice thereof.

Farms to be quarantined; inspection of premises.

"SEC. 62. The commissioner or an assistant commissioner shall order any premises, farm, or farms where such disease exists or recently existed to be put in quarantine, so that no domestic animal be removed from or brought to the premises or places quarantined, and shall prescribe such regulations as he may judge necessary or expedient to prevent the communication of the disease by infection or contagion in any way from the places so quarantined. The commissioner may adopt and enforce rules regulating the sanitation of stables and other buildings used for the stabling of cattle for the purpose of preventing the existence and spread of infection and contagion among cattle. He may provide for the inspection and examination of all such stables and buildings.

Detention and destruction of animals.

"SEC. 63. The commissioner or an assistant commissioner may order all or any animals coming into the State to be detained at any place or places for the purpose of inspection and examination. He may prescribe regulations for the destruction of animals affected with infectious or contagious disease, and for the proper disposal of their hides and carcasses and of all objects which might carry infection and contagion. Whenever in his judgment necessary for the more speedy and economical suppression or prevention of the spread of any such disease, he may cause to be slaughtered, and to be afterward disposed of in such manner as he may deem expe-

dient, any animal or animals which, by contact or association with diseased animals or by other exposure to infection or contagion, may be considered or suspected to be liable to contract or communicate the disease sought to be suppressed or prevented. The commissioner may direct that an animal shall be condemned, quarantined, or slaughtered as tuberculous, under the provisions of this article, if it shall be found to be tuberculous by a physical examination. If the owner of animals suspected of being tuberculous desires to have such animals tested with tuberculin, and enters into a written agreement with the State in the manner prescribed by the commissioner of agriculture, before such test is made, to the effect that he will disinfect his premises, and either consent to the slaughter of the animals responding to such test, or hold them and their products in strict quarantine pursuant to the directions of the commissioner of agriculture, such test shall be made by a medical or veterinary practitioner designated by the commissioner. The commissioner may also, in his discretion, order such tuberculin test to be made, and if the animal responds to such test he may cause such animal to be slaughtered or held in strict quarantine.

Employment of veterinary surgeons. "SEC. 64. The commissioner may employ such and so many medical and veterinary practitioners, and such other persons as he may, from time to time, deem necessary to assist him in discharging the duties imposed upon him by this article, and may fix their compensation to the amount appropriated therefor. No animal shall be destroyed by the commissioner, or by his order, on the ground that it is a diseased animal, unless first examined by a medical or veterinary practitioner in the employ of the commissioner, nor until such practitioner renders a certificate to the effect that he has made such examination, that in his judgment such animal is affected with a specified infectious or contagious disease, or that its destruction is necessary in order to suppress or aid in suppressing such disease, or to prevent such disease, or prevent the spread thereof, specifying the reasons for such necessity.

Regulations and the enforcement thereof. "SEC. 65. The commissioner may prescribe such regulations as in his judgment may be thought suited for the suppression or prevention of the spread of any such disease, and for the disinfection of all premises, buildings, railway cars, vessels, and other objects from or by means of which infection or contagion may take place or be conveyed. He may alter or modify, from time to time, as he may deem expedient, the terms of all notices, orders, and regulations issued or made by him, and may at any time cancel or withdraw the same. He may call upon the sheriff or deputy sheriff to carry out and enforce the provisions of any notice, order, or regulation which he may make, and all such sheriffs and deputy sheriffs shall obey and observe all orders and instructions which they may receive from him in the premises. If the commissioner shall quarantine any particular district or territory for the purpose of stopping or preventing the spread of the disease known as rabies, and if any dog be found loose within the said quarantine district in violation of said quarantine or regulations, any person may kill or cause to be killed such dog, and shall not be held liable for damages for such killing.

Penalties. "SEC. 66. Any person violating, disobeying, or disregarding the terms of any notice, order, or regulation issued or prescribed by the commissioner under this article shall forfeit to the people of the State the sum of one hundred dollars ($100) for every such violation.

Appraiser of condemned animals. "SEC. 67. The commissioner of agriculture may appoint and at pleasure remove not more than three State appraisers of condemned animals. The persons so appointed shall be persons of experience and well acquainted with the value of farm animals. They shall receive five dollars ($5) per day for the time actually employed by order of the commissioner and all necessary traveling and other expenses incurred in the performance of their duties.

Appraisal of diseased animals. "SEC. 68. One of the State appraisers of condemned animals shall be present at the examination of all diseased animals, when such examination is conducted under this act, for the purpose of determining whether such animals should be slaughtered. Such appraiser shall determine the value of each animal directed to be slaughtered. Such value shall be the market value of such animals at the time of making such examination as though the animal were not diseased, but the appraisal value of each head of cattle shall not exceed the sum of sixty dollars ($60) if a thoroughbred and forty dollars ($40) if a grade. If the value of the condemned animals determined by the appraiser is not satisfactory to the owner of such animals, the value shall be determined by arbitrators—one to be appointed by the State appraiser and one by the

owner of the animals. If such arbitrators are not able to agree as to the value of the animals, a third arbitrator shall be appointed by them. The value determined by such arbitrator shall be final. The costs and expenses of the proceedings before the arbitrators shall be paid by the owner of the animals. No cattle claimed to be thoroughbred shall be appraised as such unless the owner thereof shall furnish to the State appraiser a duly executed certificate of registry. Such appraiser of condemned animals and the arbitrators appointed under this section may administer oaths to and examine witnesses.

Certificate of appraisal. "SEC. 69. The appraiser shall execute and deliver to the owner of the condemned animals a certificate verified by him stating the appraised value of such animals. If such value was determined by arbitrators, there shall be attached to such certificate a statement of the value so determined, signed and verified by at least two of the arbitrators. The form and contents of such certificate shall be prescribed by the commissioner of agriculture.

Postmortem examination of slaughtered animals. "SEC. 70. All animals suspected of being tuberculous and slaughtered therefor shall be examined by a veterinary or medical practitioner, designated by the commissioner, for the purpose of determining whether or not such disease existed in such animals. There shall be attached to the certificate of appraisal a statement of the result of such examination, describing the animals found to be tuberculous and those which were found not to be tuberculous. The form of such statement shall be prescribed by the commissioner of agriculture. Such statement shall be verified by the veterinary or medical practitioner making the examination.

Compensation to owners of animals destroyed. "SEC. 70a. The actual appraised value at the time they are killed of all animals slaughtered under the provisions of this article, which shall be found upon a postmortem examination not to have had the disease for which they were slaughtered, unless the same were killed on account of the violation of quarantine regulations, shall be paid to the owners of such animals. The certificate of appraisal, the statement of the result of the postmortem examination, shall be presented by the owner or his legal representatives or assigns, to the commissioner of agriculture. The commissioner of agriculture shall issue his order for the amount due as shown by such certificate and statement, which shall be paid by the State treasurer on the warrant of the comptroller out of moneys appropriated therefor. The board of claims shall have exclusive jurisdiction to hear, audit, and determine all claims which shall arise under the provisions of this article for compensation for animals slaughtered and to allow thereon such sums as should be paid by the State. No compensation shall be made to any person who has wilfully concealed the existence of disease among his animals or upon his premises, or who in any way by act or by wilfull neglect has contributed to spread the disease sought to be suppressed or prevented, nor for any animal which upon a postmortem examination is found to have the disease on account of which it was slaughtered or any dangerously contagious or infectious disease that would warrant the destruction of such animal.

Expenses. "SEC. 70b. All expenses incurred by the commissioner in carrying out the provisions of this article and in performing the duties herein devolved upon him shall be audited by the comptroller as extraordinary expenses of the department of agriculture, and paid out of any moneys in the treasury appropriated for such purposes.

Federal regulations. "SEC. 70c. The commissioner of agriculture may accept, in behalf of the State, the rules and regulations prepared and adopted by the commissioner of agriculture or the Secretary or Department of Agriculture of the United States under any act of Congress for the establishment of a Bureau of Animal Industry, or to prevent the exportation of diseased cattle, or to provide means for the extirpation and suppression of pleuro-pneumonia and other contagious diseases among domestic animals, and shall cooperate with the authorities of the United States in the enforcement of the provisions of any such act.

Rights of Federal inspectors. "SEC. 70d. The inspectors of the Bureau of Animal Industry of the United States shall have the right of inspection, quarantine, and condemnation of animals affected with any contagious, infectious, or communicable disease, or suspected to be so affected, or that may have been exposed to any such disease, and for such purposes they may enter upon any ground or premises; they may call the sheriffs, constables, and peace officers to assist them in discharge of their duties in carrying out the provisions of any such act; and all sheriffs, constables, and peace officers shall assist such inspectors when so requested, and such inspectors shall have the same powers and protection as peace

officers while engaged in the discharge of their duties. All animals entering the State which pass inspection by the Federal authorities shall be permitted to proceed to place of destination without further inspection under this act. This State shall not be liable for any damages or expenses caused or made by such inspectors."

Repealing clause. SEC. 2. Article four of chapter six hundred and sixty-one of the laws of eighteen hundred and ninety-three, entitled "An act in relation to the public health, constituting chapter twenty-five of the general laws," as amended by chapter six hundred and seventy-four of the laws of eighteen hundred and ninety-four and chapter ten hundred and thirteen of the laws of eighteen hundred and ninety-five, is hereby repealed.

Appropriation. SEC. 3. The sum of ten thousand dollars ($10,000), or so much thereof as may be necessary, is hereby appropriated, out of any moneys in the treasury not otherwise appropriated, for the purposes of this act.

SEC. 4. This act shall take effect immediately.

Approved, April 11, 1901.

NORTH DAKOTA.

AN ACT Authorizing the county commissioners to build and equip dipping tanks at county expense.

Be it enacted by the Legislative Assembly of the State of North Dakota:

Dipping tanks. SECTION 1. The county commissioners of each county may, upon the petition of fifty electors and freeholders of such county, cause to be built and equipped at the principal shipping point for live stock in said county a public dipping tank, where all the live stock of such county may be dipped as a preventative of contagious, infectious, and epidemic diseases.

Plans and specifications. SEC. 2. The State veterinarians shall furnish each board of county commissioners with plans and specifications for the construction of such dipping tank whenever the commissioners shall have been petitioned as herein provided. It shall also be the duty of the State veterinarian to furnish rules and regulations necessary for the proper use of such dipping tanks by the owners of stock in their respective counties.

Expense. SEC. 3. The expense of building dipping tanks under the provisions of this act shall be paid out of the general fund of the county wherein such tank shall be built.

Emergency. SEC. 4. Whereas there will be a large number of cattle and sheep shipped into this State before July 1st next, it is important that they be dipped to prevent the introduction of disease, therefore this act shall take effect from and after its passage and approval.

Approved, March 13, 1901.

AN ACT To amend and reenact sections 1636 and 1636a of the revised codes of the revision of 1899.

Be it enacted by the Legislative Assembly of the State of North Dakota:

SECTION 1. That sections 1636 and 1636a of the revised codes of the revision of 1899 be, and the same are hereby, amended and reenacted to read as follows:

Powers of inspectors. "SEC. 1636. That five days' notice shall be given to the sheep inspectors by persons intending to bring sheep into any county in this State from another State for the purpose of grazing said sheep upon lands in this State, which notice shall state the place where such sheep are located and the nearest place to the line where the said sheep may be inspected. In all cases where scab or other contagious diseases are found in a flock of sheep the sheep inspector is hereby empowered to prescribe what dip or remedy shall be applied and specify the manner of treatment.

Duties of inspectors. "SEC. 1636a. It is hereby made the duty of sheep inspectors of this State to cause to be dipped all sheep that come into the State for the purpose of running upon or grazing on the lands of this State, which dipping shall be done under such rules and regulations as the sheep inspector may prescribe. And after said dipping the said inspector shall cause the sheep so dipped to be quarantined for not less than twenty days, or until the said sheep inspector shall be satisfied that the said sheep are entirely free from disease; pro-

vided, that this section shall not apply to sheep while on railway cars or in railway stock yards, accompanied by proper certificates of health, and which sheep are not detained in the State more than sixty hours."

SEC. 2. All acts and parts of acts in conflict with the provisions of this act are hereby specifically repealed.

Emergency. SEC. 3. Whereas the present laws of this State are vague and indefinite as to the duties of the sheep inspector in the cases herein provided, and said laws are capable of working great damage to the residents of this State, therefore an emergency exists, and this act shall take effect and be in force immediately upon its passage and appro l.

Approved March 12, 1901.

OKLAHOMA

AN ACT To provide for the protection of domestic animals, for the creation of a live-stock sanitary commission, rules and regulations, to provide penalties for violation of the same, and to repeal chapter 50 of the session laws of the Territory of Oklahoma for the year 1895.

Be it enacted by the Legislative Assembly of the Territory of Oklahoma:

Live-stock sanitary commission. SECTION 1. [As amended March 7, 1901.] That immediately upon the taking effect of this act the governor of the Territory of Oklahoma, by and with the advice and consent of the council, shall appoint three competent persons, residents of the Territory of Oklahoma, who shall hold their office for two years and until their successors are appointed, to constitute the live-stock sanitary commission of the Territory of Oklahoma. Whenever a vacancy in the membership of such commission shall occur, by reason of death, resignation, expiration of term, or removal from office, or otherwise, the governor shall appoint a successor, who shall be qualified under the provisions of this act.

Qualifications of members. SEC. 2. [Law of 1901.] Not more than two of the members of said commission shall be of the same political party, and at least two of said commission shall be cattlemen or persons of experience in cattle business.

Salaries. SEC. 3. [Law of 1901.] The members of said live-stock sanitary commission shall receive for their services while attending meetings of the commission the sum of three dollars ($3) per day and three (3) cents per mile for distance necessarily and actually traveled in attending such meetings. One member of said commission shall be appointed secretary of said commission, who shall be the executive officer of the board and shall receive a salary of one hundred dollars ($100) a month, but the secretary shall receive no per diem; the said secretary shall also receive the actual and necessary expenses of his office, not exceeding for any one year the sum of two hundred dollars ($200), said salary and expenses and per diem to be paid out of any money in the Territorial treasury not otherwise appropriated.

One inspector must be a veterinarian. SEC. 4. [Law of 1901.] One of the inspectors appointed by the live-stock sanitary commission under the provisions of the act of which this act is amendatory shall be a qualified veterinarian and a graduate of some recognized veterinary college.

Meetings of commission. SEC. 2. [As amended March 7, 1901.] A majority of the members of said commission shall constitute a quorum for the transaction of business. Said commission shall meet at any place in the Territory when necessary and may meet at various times, not to exceed thirty days in any one year, and said commission shall be paid out of the Territorial treasury, upon warrants drawn by the Territorial auditor, on the vouchers of said board.

Duties of commission. SEC. 3. [As amended March 7, 1901.] It shall be the duty of the commission provided for in the first section of this act to protect, as far as practicable, the live stock of this Territory from all contagious or infectious diseases of a malignant character, whether said diseases exist in this Territory or elsewhere, and for this purpose they are hereby authorized and empowered to establish, maintain, and enforce such quarantine lines and lines established by law, and to make all reasonable and necessary sanitary rules and regulations, and to provide rules and regulations for the enforcement and execution of the same, and

to prevent the importation and exportation of diseased live stock and the spread of infectious and contagious diseases among domestic animals. It shall also be the duty of said commission to cooperate with the live-stock sanitary commissioners, boards, and officers of other States and Territories and with the United States Secretary of Agriculture in establishing such quarantine lines, rules, and regulations as shall in their judgment best protect the live-stock industry of this Territory against contagious or infectious diseases of a malignant character, said rules to be uniform with those of the Secretary of Agriculture of the United States in regard to the prohibited period when it shall be unlawful to cross the quarantine lines established by the Secretary of Agriculture and by this act; and they are hereby empowered and authorized to make a thorough investigation as to the best manner of disinfecting animals, pens, shipping pens, and railway cars that are liable to communicate or convey contagious or infectious diseases of a malignant character to live stock, and to adopt such rules and regulations to enforce their disinfection as they may deem necessary.

That the quarantine line of the Territory of Oklahoma is established as follows, to wit: Commencing at a point where the Arkansas River crosses the Kansas State line; thence south along the Arkansas River to the northeast corner of the Ponca Indian Reservation; thence west along the north boundary line of the Ponca Indian Reservation to the main line of the railroad track of the Atchison, Topeka and Santa Fe Railroad Company; thence south on said main track to the Salt Fork of the Arkansas River; thence down said river to a point where the same empties into the Arkansas River; thence down the west bank of the Arkansas River to the line between the Ponca Indian Reservation and the Otoe and Missouria Indian Reservation; thence west on said line between the Ponca Indian Reservation and the Otoe and Missouria Indian Reservation to the main track of the Atchison, Topeka and Santa Fe Railway Company; thence down said main track to the south line of the said Otoe and Missouria Indian Reservation; thence east on a line between Noble County and said reservation to the southeast corner of said reservation; thence north on a line between said reservation and Pawnee County to the Arkansas River; thence down said river to the north boundary line of the Creek Nation; thence west along the line between the Creek Nation and the Territory of Oklahoma to the northwest corner of the Creek Nation; thence south on a line between the Creek Nation and the Territory of Oklahoma to the southeast corner of Lincoln County; thence west on a line between Lincoln County and Pottawatomie County to the northwest corner of Pottawatomie County; thence south on a line between Pottawatomie County and Oklahoma and Cleveland counties to the township line between townships seven and eight north; thence west on said line to the South Canadian River; thence westerly up said river, along the meanders of said river, to the northeast corner of the Wichita Indian Reservation; thence up said river to the northwest corner of the Wichita Reservation; thence south along a line between the Wichita Reservation and Custer County and Washita County to the southeast corner of Washita County; thence west along the line between Washita County and the Kiowa and Comanche Reservation to the North Fork of the Red River; thence down and along said North Fork of the Red River to a point of confluence with the Red River; thence up said Red River to a point where said Red River is intersected by the United States quarantine line: *Provided, however*, That the said commission may, in its discretion, establish subquarantine lines as in their judgment will best protect the people in the Kiowa and Comanche, Apache, and Wichita Indian reservations, and may, in its discretion, establish a temporary line as far south as the Red River; but it shall not be empowered to change or affect the permanent line established herein to in any manner affect the people living north of said permanent line along said reservations: *Provided*, Such cattle, if found to be healthy and free from infection upon inspection, shall be permitted to cross the Territorial quarantine line and be brought into this Territory between December first and February first of each year and at such other time as the live-stock sanitary commission of Oklahoma may order under its rules: *Provided further*, This section shall not authorize the transportation of such cattle across the Federal quarantine line.

The inspector of the district shall be removed from office if he delays any such inspection longer than is necessary: *Provided*, That if any sheriff or inspector shall be guilty of malfeasance in office, claiming authority under the quarantine laws of this Territory, he shall be civilly liable for all damage done by reason of such malfeasance.

Governor to proclaim line. SEC. 4. When said commission shall have determined quarantine lines and made rules and regulations to maintain and enforce the same to prevent the communicating or conveying of contagious or infectious diseases of a malignant character to live stock within this Territory as heretofore provided, the governor of the Territory of Oklahoma, when-

ever advised and directed by said commission, shall issue his proclamation setting forth and proclaiming the boundary and location of said quarantine line or lines, the orders, rules, and regulations so prescribed by said commission, and the issuance of said proclamation shall be due and public notice of its provisions, and no further notice or publication of the same shall be necessary.

Districts. SEC. 5. The said live-stock sanitary commission shall divide the Territory of Oklahoma into three separate districts and define the boundaries thereof, and shall assign the inspectors appointed under this act, one to each respective district. Said inspectors shall have power to act throughout the Territory, and it shall be their duty to communicate any information or aid in any manner the inspectors of the other districts in the performance of their duties. Each inspector shall have a fixed or permanent address within his district, which said address, together with the boundaries of his district and the full name of the inspectors, shall be published in the proclamation of the governor, as hereinbefore provided.

Inspectors. SEC. 6. There shall be appointed by said commission three live-stock inspectors, one of same from each one of the three political parties of this Territory, one to be a Democrat, one a member of the People's Party, or Populist, and one a Republican, and should the place of any inspector be made vacant by death, resignation, or otherwise, his successor shall be appointed from the same political party of which he was a member. They shall be qualified and learned in the diseases of domestic animals, and shall first pass satisfactory examination before said commission. Said inspectors shall act under the orders and instructions of said commission, and shall [have] full power to execute the orders thereof and to do all things necessary to the enforcement and execution of the rules and regulations thereof, and the rules of the Secretary of Agriculture of the United States. They shall hold their office for the period of two years from the date of appointment, and subscribe to the oath of office, and give bond to the Territory of Oklahoma in the sum of one thousand dollars ($1,000) each for the faithful performance of all duties enjoined upon them by law or the live-stock sanitary commission. Said inspectors shall render all reports and accounts to said commission, and shall receive three dollars ($3) per day for the time employed in the discharge of their duties, and five hundred dollars ($500) a year, and no more, or so much thereof as is necessary for actual expenses incurred in the discharge of their duties, which said salary and expenses shall be paid out of the treasury of the Territory of Oklahoma on auditor's warrants issued upon the vouchers of said commission.

Powers of inspectors. SEC. 7. The inspectors appointed and acting under the provisions of this act shall have power to enter upon any premises, or into any barn, lot, corral, shed, or pasture for the purpose of inspecting or disinfection. If upon examination he is satisfied that said premises, barn, lot, corral, shed, or pasture is infected with any contagious or infectious disease of a malignant character, or needs disinfecting, he shall possess himself thereof and may exclude any and all persons from interference with his possession thereof, and establish such rules and regulations as he may deem necessary until he shall be satisfied that the same is free from such infection. Any person or persons who shall interfere with said inspector's possession of said premises, barn, lot, corral, shed, or pasture, or violate any of the rules and regulations made by him for the protection or disinfection of same, while the same is under his control or possession, shall be guilty of a misdemeanor, as provided in section 13 of this act.

Duties of inspectors. SEC. 8. It shall be the duty of the inspectors under this act to enforce all the provisions of this act, and the rules and regulations of the live-stock sanitary commission, and the rules and regulations of the Department of Agriculture of the United States thereunder. Whenever notified by the sheriff or any person that any live stock, pastures, barns, lots, corrals, sheds, or range are affected or infected with any contagious or infectious diseases of a malignant character, he shall at once proceed to the inspection of said live stock, pastures, barns, lots, corrals, sheds, or range, and if he shall consider the same affected or infected shall immediately establish rules and regulations governing the movement of said live stock or possession and use of said pastures, barns, lots, corrals, sheds, or range, or of the disinfection thereof, and if necessary shall place the same in possession of and under control of the sheriff, if he be not already in control.

Stock crossing line illegally. SEC. 9. If any live stock shall be led, drifted, driven, or transported across any quarantine line established by the Department of Agriculture of the United States, the live-stock sanitary commission of the Territory of Oklahoma, the quarantine line in the Territory of Oklahoma as herein established, or of the live-stock inspectors, into or upon

any part of the Territory of Oklahoma protected by said quarantine lines, during the prohibited period as prescribed by the live-stock sanitary commission or its inspectors, or the laws of Congress, and the Territory of Oklahoma and the proclamation issued under authority thereof, the inspectors shall have the power to seize said live stock, and may call to their aid the sheriff of the county where said live stock is found, and shall either place same under quarantine regulations or return said live stock back across said line into the territory from whence they came, and the costs and charges of the sheriff, which shall be the same as in the case of personal property taken under execution, shall be a lien upon said live stock, and he may sell all or a part thereof to pay the same, as provided in section 10 of this act, and the person or persons who shall be in charge of said live stock, or shall have the same in their possession, shall be deemed guilty of a misdemeanor, and upon conviction shall be punished as provided in section 13 of this act.

Powers of sheriff. SEC. 10. It shall be the duty of any sheriff of any county within this Territory, upon a complaint made to him, or otherwise having notice or knowledge that there is within the county where the officer resides live stock believed to be affected or infected with a contagious or infectious disease of a malignant character and liable to communicate or convey the same to any live stock, or that any live stock has been driven, led, moved, shipped, or drifted, or in any manner transported into or through any portion of this Territory in violation of any rules, regulations, or orders of the live-stock sanitary commission, he shall immediately take charge of and restrain said live stock under such temporary regulations as will prevent the communicating or conveying of said disease, and he shall immediately notify the live-stock inspector of his district; and said sheriff shall keep said stock in his custody until the arrival of the live-stock inspector, who shall immediately take such steps as he may deem necessary for the protection of the live-stock interests of that locality. All live stock so seized by any sheriff shall be kept and held in his custody, subject to such quarantine regulations as he shall receive from said live-stock inspector, unless he shall receive further orders from the said live-stock inspector to deliver said live stock to the owner or owners. No officer who shall take or detain any live stock under the provisions of this act shall be liable to the owner or owners of such live stock for any damage by reason of such taking or detention, or by reason of the performance of any other duty enjoined in this act. Before any live stock shall be delivered as aforesaid, there shall be paid to the officer having said live stock in custody all costs and expenses of taking, detaining, or holding, or disinfecting, and in case such costs and expenses are not paid, said officer shall advertise in the same manner as provided by law in cases of the taking, caring for, and sale of personal property upon execution, and he may sell such live stock or such portion thereof as may be necessary to pay his costs and expenses of sale, and he shall forthwith pay over to the owner or owners any amount so received in excess of the legal fees and expenses of such officer.

Moving diseased stock. SEC. 11. Any person, persons, or corporation who shall drive, lead, move, drift, ship, transport, or cause to be driven, led, moved, drifted, shipped, or transported into or through any county or part thereof in this Territory within the area protected by and included within quarantine or boundary lines described by the live-stock sanitary commission, or one of the inspectors appointed thereby, any live stock affected or infected with a contagious or infectious disease of a malignant character, and liable to communicate or convey such disease to live stock within said area, shall be guilty of a misdemeanor, and upon conviction thereof shall be fined in the sum of not less than one hundred dollars ($100) nor more than five thousand dollars ($5,000), and may be imprisoned in the county jail not less than thirty days nor more than one year, or may be punished by both such fine and imprisonment, and in addition thereto shall be liable to any person or persons injured thereby for all damages they may sustain by reason of the communicating or conveying of such disease, to be recovered in a civil action in any court of competent jurisdiction, and the party so injured shall have a first and prior lien to all other liens for such damages upon the live stock communicating or conveying such disease: *Provided, however*, That nothing in this act shall be construed to effect [affect] the laws of Congress governing interstate commerce.

Disinfecting railroad cars. SEC. 12. It shall be the duty of the railway corporations doing business in this Territory, and they are hereby required, to disinfect the shipping pens and cars used by them in transporting live stock in or through this Territory, in such manner and at such times and places as the said commission may order and designate; and any such corporation violating any of the provisions of this section shall be liable to a penalty of not less than one hundred dollars ($100) and not more than five thousand dollars ($5,000) for each violation of any of said regulations or rules of said commission, to be recov-

ered in a civil action to be prosecuted by the attorney-general, or under his direction, in the name of the Territory of Oklahoma, in the district court of Logan County, Territory of Oklahoma, or any county where such violation may have occurred.

Penalty for violation of quarantine laws.

SEC. 13. Any person or corporation who shall, in violation of any of the rules, regulations, orders, or directions of the live-stock sanitary commission, or any of its live-stock inspectors, fixing, establishing, or maintaining quarantine lines or local quarantine rules and regulations within this Territory against contagious or infectious diseases of a malignant character, drive, lead, move, drift, ship, or in any manner transport any live stock across said lines or any of them, or violate any local quarantine rules and regulations, or in any manner interfere, interrupt, or obstruct the live-stock sanitary commission or any of its live-stock inspectors in the discharge of their duty, shall be guilty of a misdemeanor, and shall for each offense, upon conviction, be fined in the sum of not less than one hundred dollars ($100) nor more than one thousand dollars ($1,000), or be imprisoned in the county jail for not less than thirty days nor more than one year, or may be punished by both such fine and imprisonment, and shall be liable in a civil action for all damages caused by violation of this act.

Condemnation of stock and payment for same.

SEC. 14. Whenever any live stock within this Territory shall be found by the live-stock inspectors to be affected with rinderpest, foot-and-mouth disease, glanders, maladie du coït, or contagious pleuropneumonia, he shall summon three disinterested householders and cause said stock so affected to be appraised, which appraisement shall be upon the value of the stock at that time. He shall then kill said stock and dispose of the carcasses thereof in such manner as will, in his judgment, best protect the health of the domestic animals of that locality. The inspector shall forward his report of animals killed, disease with which affected, name of owner, and the appraisers' certificate to the secretary of the live-stock sanitary commission. The said commission shall audit the account, if correct, and forward the voucher to the auditor of the Territory, who shall draw his warrant upon the Territorial treasurer for the amount, and who shall pay the same out of the general funds of said Territory: *Provided, however*, That if said stock contracted the disease from without the Territory, or if the owner thereof has violated any quarantine regulations of the Territory or of the United States Government, or if he became the owner thereof with the knowledge that said stock was affected with said disease, the Territory shall not be liable for the value thereof.

Criminal prosecutions.

SEC. 15. It shall be the duty of the county attorney of the proper county to prosecute, on behalf of the Territory, all criminal cases arising under this act. For each conviction of an offense under this act said county attorney shall receive, in addition to his salary already provided, the sum of twenty-five dollars ($25), to be taxed as costs in the case.

Butchers to notify inspectors.

SEC. 16. It shall be the duty of the inspectors provided for by this act to provide themselves with record books, in which they shall record age, brand, and color of all cattle slaughtered within their respective districts for the purpose of sale to the public, either wholesale or retail, and to appoint in each county of his district one or more deputies for the purpose of inspecting animals for slaughter, as provided for by this act, whenever he shall be requested to so appoint by a petition in writing signed by fifty qualified voters of said county. It shall be the duty of all persons slaughtering cattle for public sale and use to notify the inspector of the district or his local deputy appointed by him for that purpose of their intention so to do. The inspector or his deputy shall at once proceed to inspect said cattle; and if he shall find that they are affected or infected with any disease which will render them unfit for human food, he shall inform the person not to slaughter the same; but should such cattle be found to be free from all disease, then he shall record the color, age, and brands of same, and said cattle shall be considered fit for slaughter and sale. Any person offering the meat of cattle for sale without having them inspected as aforesaid shall be deemed guilty of a misdemeanor, and upon conviction thereof be fined ten dollars ($10) for every animal so unlawfully slaughtered. The inspectors or their deputies shall be entitled to a fee of twenty-five (25) cents for each head of cattle inspected, to be paid by the person having the same done.

Inspectors' weekly reports.

SEC. 17. It is hereby made the duty of all inspectors in this Territory at the end of each week to transmit to the secretary of the live-stock sanitary commission a report showing in detail the number of animals inspected by him or his deputies during the week; the number rejected as being unfit for human food, with recommendations as to the disposi-

tion to be made of the same; the number of animals recommended as fit for slaughter, with a complete description of the marks and brands on each animal inspected, giving location of the same, and to give the person slaughtering the animal a duly certified health certificate with the description of the animal or animals found to be fit for human food, the certificate to contain all marks and brands upon said animal or animals.

Sheriffs to report violations. SEC. 18. It is hereby made the duty of all sheriffs in this Territory to at once make known to the county attorneys and to the grand juries of their respective counties any and all violations of any of the provisions of this act which may come to their knowledge and to said live-stock inspectors and other proper authorities of this Territory in the enforcement of the rules and regulations and orders of said commission and inspectors, and of any and all the provisions of this act; and all district judges are hereby required to give this act in charge to the grand juries of their respective counties at each term of the courts thereof.

Venue. SEC. 19. Any person who violates any of the provisions of this act as hereinbefore mentioned may be prosecuted in the county of his residence, or in any county in this Territory in which he may be found, or in any county in which any live stock owned or controlled by him may be found in violation of any of the provisions of this act, or in any county in which any violation of any provision of this act may be committed by him.

General penalty. SEC. 20. Except as otherwise provided for in this act, any person who shall violate, disregard, or evade, or attempt to violate, disregard, or evade, any of the provisions of this act, or who shall violate, disregard, or evade, or attempt to violate, disregard, or evade, any of the rules, regulations, directions, or orders of the live-stock sanitary commission or any of its live-stock inspectors shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be fined in the sum of not less than one hundred ($100) nor more than five thousand dollars ($5,000), or be imprisoned in the county jail for not less than thirty days nor more than one year, or may be punished by both such fine and imprisonment.

Repeal of chapter 50. SEC. 21. That all of chapter 50 of the session laws of the Territory of Oklahoma for the year 1895 is hereby repealed.

SEC. 22. This act shall be in force and effect from and after its passage and approval.

Approved, March 9, 1897.
[Sections 1, 2, and 3, as amended and added to, approved March 7, 1901.]

OREGON.

AN ACT To create the office of State bacteriologist, without salary.

Be it enacted by the Legislative Assembly of the State of Oregon:

State bacteriologist. That the office of State bacteriologist, without salary, is hereby created, and that the governor of the State is hereby authorized to appoint a person properly qualified by scientific attainments to serve in that capacity. The duties of such officer shall be the scientific investigation of animal and plant diseases and recommendations of remedies for their elimination. He shall from time to time make a brief report of the progress of his work to the governor of the State.

Approved, February 27, 1901.

PENNSYLVANIA.

AN ACT To provide for the investigation of the diseases of domestic animals, and making an appropriation therefor.

Be it enacted, etc.,

Appropriation. SECTION 1. That the sum of ten thousand dollars ($10,000), or so much thereof as may be necessary, be, and the same is hereby, specifically appropriated out of any money in the treasury not otherwise appropriated, for the purpose of conducting investigations concerning the causes, nature, treatment, and prevention of the diseases of the domestic animals of the Commonwealth of Pennsyl-

vania, with the object of discovering new facts which may be applied advantageously and profitably by the owners of live stock and those engaged in the care and rearing of animals.

Method of investigation. SEC. 2. That such investigations shall be made by and under the direction of the State live-stock sanitary board, and the said board is hereby authorized to provide for and conduct such work of investigation as may be necessary to discover the most efficient, economical, and practical means of avoiding and suppressing the diseases of the domestic animals of the Commonwealth; and such work, and the practical deductions therefrom, shall, upon the order of the secretary of agriculture, be published as a part of the annual report of the department of agriculture, or as bulletins of said department: *Provided, however*, That before any expenses shall be incurred under the provisions of this act, it shall first be approved by the governor and the secretary of agriculture. The said appropriation is to be paid upon the warrant of the auditor-general, on the presentation of specifically itemized vouchers and the written approval of the governor and secretary of agriculture as herein provided.

Approved, July 18, 1901.

To provide for the prevention of the spread of disease from the carcasses of animals that die of dangerous or virulent diseases, or are killed while afflicted with such diseases; to provide for the safe disposal or destruction of such carcasses; to authorize the State live-stock sanitary board to make regulations for the enforcement of this act; to provide penalties for the violations of the act and of the regulations that may be made under it by the State live-stock sanitary board.

Be it enacted, etc.:

Diseased carcasses must be destroyed. SECTION 1. That when any domestic animal may die, or be killed while afflicted with an infectious, contagious, germ, or parasitic disease, adjudged by the State live-stock sanitary board to be of a dangerous or virulent character, and in particular when any domestic animal may die or be killed while it is afflicted with any one of the diseases known as anthrax, black quarter, hog cholera, swine plague, rabies, or glanders, the owner or owners of such animals shall at once destroy or dispose of the carcass of such animal by one of the methods herein provided.

Methods of destruction. SEC. 2. The methods of destruction or disposal shall be of a kind that will completely destroy or securely sequester the poison, germ, parasite, or infective agent of the disease with which the animal was afflicted at the time of death. The following methods of destruction or disposal shall be allowed: (1) Complete burning or cremation of the carcass and of all its parts and products. (2) Boiling the carcass and all of its parts and products in water, or heating the same with steam, at the temperature of boiling water, for at least two hours. (3) Burying the carcass and all of its parts and products in a place that is not subject to overflow from ponds or streams, that is distant not less than one hundred feet from any water course, well, spring, public highway, or building used as a house or stable, and in the following manner, to wit: The grave shall be of such a depth that when the carcass and parts and products thereof are placed in it, and the grave is filled with earth and the top is smoothed to the level of the surrounding surface, the uppermost part of the carcass and all of its parts and products shall be completely covered; and, further, the grave shall be so protected that the carcass can not be dug out or exposed by dogs or animals. Before the carcass and its parts and products are covered with earth they shall be covered with lime to a depth of not less than three inches. Any other method of destroying or disposing of carcasses, and of the parts and products of carcasses, may be practiced that is specifically approved by the State live-stock sanitary board.

Penalty for noncompliance. SEC. 3. If any person owning an animal that dies while it is afflicted with anthrax, black quarter, hog cholera, swine plague, rabies, or glanders, or any other infectious, contagious, germ, or parasitic disease that is adjudged by the State live-stock sanitary board to be of a dangerous or virulent character, shall, after notification by anyone, neglect within twenty-four hours to destroy or dispose of the carcass and its parts and products in accordance with the provisions of section two of this act, the said person shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be punished by a fine of not less than ten dollars ($10) nor more than one hundred dollars ($100), at the discretion of the court.

Failure to destroy diseased carcass. SEC. 4. When the carcass and products of any animal that died while afflicted with any of the diseases specified in section one of this act or of any infectious, contagious, germ, or parasitic disease adjudged by the State live-stock sanitary board to be of a dangerous or virulent character, is not disposed of or destroyed in one of the ways set forth in section two of the act, and this fact shall be brought to the attention of an agent of the State live-stock sanitary board, the board of health of the township, borough, or city in which the death occurs or in which the carcass of the animal may be; or when this fact shall be brought to the attention of any member of such board of health, or in the event that there is no board of health having jurisdiction, when any township's auditor, of a township in which such a carcass may be, is notified of the fact, it shall be the duty of the said agent of the State live-stock sanitary board or member of a board of health, or said health board, or said township auditor, to at once cause the carcass and its parts and products to be disposed of or destroyed in accordance with the methods prescribed in section two of this act.

The disposal or destruction of the carcass shall be carried out in a way that is as economical as is compatible with efficiency and safety, and a fully itemized bill of expense incurred shall be drawn up by the agent of the State live-stock sanitary board, the board of health, or the board of township auditors and forwarded as a voucher to the State live-stock sanitary board. If the voucher is approved by the said board, it shall be paid in the same manner as other expenses of said board are paid: *Provided, however*, That no charge shall be paid of more than ten dollars ($10) for the destruction of a single carcass of a horse, mule, cow, bull, or ox; nor more than three dollars ($3) for the destruction of a single carcass of a colt, calf, sheep, hog, or dog.

Owners must pay for destruction. SEC. 5. The cost of the destruction of the carcass or carcasses as hereinbefore provided shall constitute a lien on the property of the owner or owners of the animals at the time of their death, and it shall be the duty of the State live-stock sanitary board to attempt to recover, and if possible to recover, by due process of law, from said owner or owners, the amounts expended by it for disposing of or destroying the carcasses of their animals in the enforcement of this act.

Approved May 2, 1901.

SOUTH CAROLINA.

AN ACT To authorize and empower the board of trustees of Clemson College to promulgate and enforce rules and regulations for the guidance of the veterinarian of said college in the treatment or destruction of animals affected with contagious diseases.

Be it enacted by the General Assembly of the State of South Carolina:

Board of trustees may make rules. SECTION 1. That the board of trustees of Clemson College shall have the right to promulgate and enforce rules and regulations for the guidance of the veterinarian of said college, or his assistant, if one shall be appointed, in the treatment of horses, mules, cattle, hogs, or other live stock affected with any dangerous or contagious disease.

To prevent disease entering the State. SEC. 2. That the said board shall have the power to adopt rules and regulations, consistent with the laws of this State and of the United States, to prevent the introduction into this State of any live stock that is affected with any contagious disease the tendency of which is to cause the death of said live stock.

Unlawful to sell diseased animals. SEC. 3. It shall be unlawful to sell or offer for sale in this State any horse, mule, cattle, hog, or any other live stock that is known to be affected with any contagious disease the tendency of which is to cause the death of any such live stock; and any person or persons violating the provisions of this section shall be deemed guilty of a misdemeanor, and upon conviction shall be fined in a sum not exceeding one hundred dollars ($100), or be imprisoned in the county jail not exceeding thirty days.

Powers of veterinarian. SEC. 4. That the said veterinarian shall have the right to visit any section of this State where contagious diseases among animals is believed to exist, and shall determine, under the rules and regulations of the said board, whether such affected animals are worthy of remedial treatment or should be destroyed. It shall not be lawful for any person or persons to hinder or obstruct said veterinarian or his assistant in the enjoyment of the

rights given by this section or in the discharge of the duties prescribed by this [the] next succeeding section; and any person or persons violating the provisions of this or the next succeeding section shall be guilty of a misdemeanor, and upon conviction shall be punished as prescribed in section three of this act.

SEC. 5. When two or more reputable citizens of any county in this State shall notify said veterinarian that any animals in their county are affected with a contagious disease the tendency of which is to cause the death of such animals, he shall investigate the same, or cause an investigation thereof to be made; and for such purpose he or his assistant shall have the right to go upon any premises on which such affected animals are or where they are supposed to be. Said veterinarian shall have the right to treat such affected animals at the expense of the owner or owners of the same, or shall have the right to cause the same [to be] destroyed, under such rules and regulations as may be prescribed by the said board. No compensation shall be paid to the owner or owners of any animals destroyed under the provisions of this section. The necessary expenses incurred by the veterinarian or his assistant in the discharge of the duties prescribed in this act shall be paid from the funds of Clemson College.

SEC. 6. This act shall take effect from its passage; and all acts and parts of acts inconsistent herewith are hereby repealed.

Approved February 19, 1901.

SOUTH DAKOTA.

AN ACT Providing penalties for the unlawful transportation of diseased swine.

Be it enacted by the Legislature of the State of South Dakota:

Duty of officers. SECTION 1. It shall be the duty of every sheriff, deputy sheriff, constable, or other peace officer, whenever he learns or is informed that any person is unlawfully engaged in the transportation of diseased swine, or swine that have died from any disease, to forthwith examine into the matter, and upon being satisfied of the truth thereof to immediately seize the outfit so engaged and arrest the person or persons in charge thereof and bring them before some magistrate for further proceedings in conformity with the provisions of chapter 131 of the session laws of 1899.

Disposition of diseased swine. SEC. 2. In all cases where a conviction is had upon such arrest and the court finds that the swine so seized are affected with or have died from any swine disease, the court shall order the officer making such seizure to forthwith burn or bury such swine, as provided by law, and also to burn the wagon or other vehicle in which said swine were found: *Provided*, That if such wagon or other vehicle can be thoroughly disinfected at a less cost than the value of such wagon or other vehicle, then the court shall order the officer to thoroughly disinfect such wagon or other vehicle and the reasonable cost and expense of such disinfection shall be a lien upon such wagon or other vehicle and the officer may retain possession of the same until such cost and expense is paid: *Provided further*, That if the same be not paid within ten days then such officer shall sell such wagon or other vehicle to satisfy such cost and expense as for a pledge.

Officer's fees. SEC. 3. The officer making such seizure and performing such services, shall, in addition to the fees now allowed by law, be entitled to and receive one-half of the fine imposed, and in case such fine is not collected shall receive in lieu thereof and in addition to his other fees the sum of ten dollars ($10).

SEC. 4. All acts and parts of acts in conflict with the provisions of this act are hereby repealed.

Approved March 4, 1901.

AN ACT To amend section 2333 of the compiled laws.

Be it enacted by the Legislature of the State of South Dakota:

State veterinarian. SECTION 1. That section 2333 of the compiled laws be and the same is hereby amended to read as follows:

"SEC. 2333. The veterinary surgeon shall receive for his services the sum of twelve hundred dollars ($1,200) per annum, together with his necessary traveling expenses actually paid out when in performance of his duty. These payments shall be made

from any funds in the State treasury not otherwise appropriated, upon itemized vouchers signed and sworn to by him and submitted to the State auditor, who shall draw warrants upon the State treasurer for the amounts found correct, separate vouchers being made for salary and expenses. No person shall be competent under this act to receive the appointment of veterinary surgeon who is not at the date of his appointment a graduate in good standing of a recognized college of veterinary surgeons and of not less than five years' actual practice. He shall hold his office for two years. He may be removed for cause by the governor, who shall also have power to fill the vacancy as hereinbefore provided. The appraisers herein provided for shall each receive three dollars ($3) for each day or part of a day they may be actually employed as such, which shall be paid from the State treasury out of the stock-indemnity fund hereinafter provided, upon vouchers which bear the certificate of the justice who summoned them. The justice of the peace shall receive for his services the fees provided by law for similar services, to be paid out of the county general fund. The veterinarians, physicians, or freeholders called in consultation by the veterinary surgeon shall each receive three dollars ($3) for each day or part of a day they may be actually so employed and five (5) cents per mile mileage for distance necessarily traveled, which sums shall be paid from the State treasury out of the stock-indemnity fund hereinafter provided for, upon vouchers certified to by the veterinary surgeon, and other incidental expenses connected with his work and made his duty by this act, such as causing animals to be slaughtered and their carcasses to be burned or buried, and disinfecting infected premises, shall be paid from the State treasury out of the stock-indemnity fund hereinafter provided for, upon vouchers certified to by him under oath. Before entering upon the discharge of his duties he shall give a bond to the State of South Dakota, with good and sufficient surety, in the sum of ten thousand dollars ($10,000), conditioned for the proper discharge of the same. No constructive mileage shall be paid under this act, nor shall the veterinary surgeon receive any mileage."

SEC. 2. All acts and parts of acts in conflict with this act are hereby repealed.

SEC. 3. An emergency is hereby declared to exist, and this act shall take effect and be in force from and after its passage and approval.

Approved, February 28, 1901.

TENNESSEE.

AN ACT To create the office of State live-stock inspector, to provide for the appointment of the inspector, fix his salary, define his duties, and provide for the appointment of his deputies.

Be it enacted by the General Assembly of the State of Tennessee:

Appointment of inspector. SECTION 1. That the commissioner of agriculture or secretary of the board or department of agriculture shall appoint, at a salary of $1,500 per annum and his traveling expenses while in discharge of his duties, some competent person, to be known as State live-stock inspector, whose term of office shall be two years from the date of his appointment, or until his successor is elected and qualified: *Provided*, That said commissioner, or the secretary in conjunction with the members of the said board or department of agriculture, shall have power to remove from office said inspector.

Duties of inspector. SEC. 2. *Be it further enacted*, That said live-stock inspector shall devote his time exclusively to the protection of the live-stock interests of the State, and shall be charged especially with the formulation and enforcement of all rules and regulations for quarantining against or otherwise preventing and for eradicating communicable diseases among domestic animals in the State, as provided for in all the public acts upon this subject.

Deputy inspectors. SEC. 3. *Be it further enacted*, That said live-stock inspector shall be empowered to appoint, for definite periods of time by him designated, and at salaries fixed by him, not to exceed $75 per month each and their actual expenses, itemized and sworn to, three deputy inspectors, one for each grand division of the State: *Provided*, That the salaries of himself and his deputy inspectors and all expenditures made by him shall not exceed the amount specifically appropriated for this purpose: *And provided further*, That neither said State live-stock inspector nor any of his deputies shall have any power to expend any other funds of the State, nor to charge the State with any further liability: *Provided further*, That the appoint-

ment of the deputy inspectors shall be approved by the bureau or board of agriculture before they enter upon the discharge of their duties.

Inspector to make quarterly report. SEC. 4. *Be it further enacted*, That said State live-stock inspector shall make to the commissioner of the bureau of agriculture a quarterly report of all moneys received and all disbursements made by him during the preceding quarter, accompanied by the proper vouchers.

SEC. 5. *Be it further enacted*, That any and all laws or parts of laws in conflict with this act be, and the same are hereby, repealed.

SEC. 6. *Be it further enacted*, That this act shall take effect from and after its passage, the public welfare requiring it.

Approved, April 16, 1901.

AN ACT To prevent the spread of communicable diseases among domestic animals in the State of Tennessee, and to provide greater protection to the live-stock industry of the State, and to provide penalties for the violation of this act, and to repeal chapter 424 of the acts of 1879, and to amend chapter 46 of the acts of 1897.

Be it enacted by the General Assembly of the State of Tennessee:

Owners must report disease. SECTION 1. That it shall be the duty of the owner or person in charge of any domestic animal or animals who discovers, suspects, or has reason to believe that such animal or animals as aforesaid are afflicted with any communicable disease, to immediately report the fact, belief, or suspicion to the county board of health of the county in which said domestic animal or animals are found.

State officials to cooperate. SEC. 2. *Be it further enacted*, That it shall be the duty of the commissioner of agriculture and State live-stock inspector to cooperate with the officials of the Federal Government, and with those of other States, in establishing interstate quarantine lines, and in enforcing such rules and regulations as shall best protect all live-stock industry of the State against splenetic, or Texas, fever.

Investigation of outbreaks. SEC. 3. *Be it further enacted*, That the county board of health of each county, whenever any case or cases of communicable disease among the domestic animals of their county is reported to exist, shall immediately cause the same to be investigated, preferably by a qualified veterinarian, and should such investigation show a reasonable probability that such animal or animals are affected with a communicable disease the said county board of health shall immediately establish such temporary quarantine as may be necessary, in their judgment, to prevent the spread of disease, and shall without delay report all action taken to the State live-stock inspector, and the acts of the said county board of health establishing said temporary quarantine shall have the same force and effect as though established by the commissioner of agriculture and the State live-stock inspector, until such time as they shall take charge of the case or cases, and the county board of health of every county in the State shall adopt and enforce such rules and regulations as said commissioner of agriculture and the State live-stock inspector may prescribe, having for their object the prevention and restriction of splenetic, or Texas, fever, or any other communicable disease, among domestic animals which may be either threatened or developed in such localities. And all expenses incurred by the county boards of health in carrying out the provisions of this act shall be a county charge, and shall be paid in like manner as other expenses of the county now are.

Violation of quarantine law. SEC. 4. *Be it further enacted*, That any person, firm, or corporation who shall knowingly import or introduce any cattle or other domestic animal into the State of Tennessee from any district south of the quarantine line, as established, or as may be established by the Secretary of the United States Department of Agriculture, or Congress, which is affected with splenetic, or Texas, fever, or which bears upon its or their body or bodies fever ticks (*Boophilus bovis*), or other causes of said diseases, unless such cattle so introduced or imported are immediately slaughtered, or are brought into the State in conformity with such rules and regulations as may be prescribed by the commissioner of agriculture and State live-stock inspector, shall be guilty of a misdemeanor, and, upon conviction thereof, shall be fined in any amount not less than five hundred dollars ($500) nor more than five thousand dollars ($5,000), or confined in the

county jail for not less than one nor more than three years, in the discretion of the court.

Owners must submit to investigation.

SEC. 5. *Be it further enacted*, That any person who owns or is in possession of live stock reported or suspected to be affected with any communicable disease, or with insects which may produce such disease, who shall refuse to allow said county board of health, or anyone acting under its orders, or the State live-stock inspector, or anyone acting under his orders, to examine such stock, or who shall hinder or obstruct any of them in any examination of or in any attempt to examine such stock, shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be fined in any sum not less than fifty dollars ($50) nor more than two hundred dollars ($200).

Owners must confine diseased animals.

SEC. 6. *Be it further enacted*, That any person who shall have in his or her possession any domestic animal affected with any communicable disease or fever tick, knowing such animal to be affected, who shall permit such animal or animals to run at large, or who shall keep such animal or animals where other domestic animals not affected by or previously exposed to such communicable disease, may be exposed to its contagion or infection, or who shall ship, drive, sell, traffic, or give away such animal or animals which have been exposed to such infection or contagion, or who shall move or drive any domestic animal in violation of any direction, rule, regulation, or order of said commissioner of agriculture or live-stock inspector establishing and regulating live-stock quarantine, or the restriction or spread of communicable diseases among domestic animals, shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be fined in any amount not less than fifty dollars ($50) nor more than one hundred dollars ($100) for each of such exposed or diseased domestic animals which he or she shall permit to run at large, or sell, ship, drive, trade, or give away in violation of the provisions of this act: *Provided*, That any owner of domestic animals which have been affected with or exposed to any communicable disease may dispose of the same after having obtained from said commissioner of agriculture, or the live-stock inspector, or the State veterinary surgeon, a certificate of health for such animal or animals.

General supervision.

SEC. 7. *Be it further enacted*, That the commissioner of agriculture and the State live-stock inspector shall have the general supervision of all communicable diseases among domestic animals within, or that may be in transit through the State, and they are empowered to establish quarantine against any animal or animals thus diseased, whether within or without the State, and may make such rules and regulations against the spread and for the suppression of said disease or diseases as in their judgment may seem necessary and proper; and in the enforcement of such rules and regulations they shall have the power to call on any one or more of the peace officers, whose duty it shall be to give all the assistance in their power.

Quarantine must not be evaded.

SEC. 8. *Be it further enacted*, That any person who wilfully hinders, obstructs, or otherwise disregards or evades such quarantine as they may declare, or violate any rule or regulation they shall make in attempting to stamp out or restrict the spread of any disease or diseases aforementioned, or who shall resist any peace officer acting under them, or either of them, shall be guilty of a misdemeanor, and upon conviction shall be fined not less than fifty dollars ($50) nor more than five hundred dollars ($500), or imprisoned in the county jail for a period of three months, or both, at the discretion of the court.

Owners to report outbreaks.

SEC. 9. *Be it further enacted*, That in the event of any communicable disease aforesaid breaking out or being reasonably suspected to exist in any locality in this State it shall be the duty of the local health authorities, or persons owning or having any interest whatever in said animals, immediately to notify the said live-stock inspector of the fact, when he shall institute such measures for the restriction or stamping out of such disease or diseases as he may think necessary. Any person or persons specified who shall neglect or refuse to notify said live-stock inspector of the existence of any communicable disease, as aforementioned, shall be guilty of a misdemeanor, and upon conviction shall be fined not more than ten dollars ($10), or confined in the county jail not exceeding two months, or both, at the discretion of the court.

Valuation of condemned animals.

SEC. 10. *Be it further enacted*, That whenever, in the opinion of the State live-stock inspector, the public safety demands the destruction of any animal or animals under the provisions of this act, he shall, before ordering the killing or slaughter-

ing of the same, appoint three competent and disinterested freeholders, who shall be affirmed or sworn before proceeding to act, and they shall make a just and true valuation of said animal or animals to be so killed or slaughtered, and in valuing shall consider the health and condition of the animal when killed, and they shall make and deliver a written certificate, setting forth all the essential facts in the case to the lawful owner, who shall present the same for payment to the chairman of the county court of the county in which such animal or animals are so killed or slaughtered, and the same shall constitute a county charge, to be paid as other claims against the county are.

Trading in diseased stock. SEC. 11. *Be it further enacted*, That any person or persons who knowingly shall import or bring into this State any animal or animals affected with pleuropneumonia, rinderpest, glanders, or any other communicable disease, or who shall sell or trade, or offer for sale or trade, any animal or animals so diseased, shall be guilty of a misdemeanor, and upon conviction shall be punished by a fine of not more than one hundred dollars ($100), or imprisoned in the county jail for a period not exceeding three months, or both, in the discretion of the court.

Federal action. SEC. 12. *Be it further enacted*, That the governor of the State, with the commissioner of agriculture and the State live-stock inspector, may cooperate with the Government of the United States for carrying out the purposes of this act, and the governor is hereby authorized to receive and receipt for any moneys receivable by this State under the provisions of any act of Congress which may at any time be in force upon this subject, and to pay the same into the State treasury, to be used according to the act of Congress and the provisions of this act as nearly as practicable.

County inspector. SEC. 13. *Be it further enacted*, That there may be appointed by the county board of health of each county in the State a competent person, to be known as county live-stock inspector, and whose appointment shall be ratified or rejected at the first term of the quarterly court following appointment, whose duty it shall be to look after the detection and suppression of communicable diseases among domestic animals in his county, and whose compensation shall be fixed by the county court of his county and paid out of the county treasury.

Veterinary surgeon. SEC. 14. *Be it further enacted*, That the commissioner of agriculture and the State live-stock inspector may, when they see proper, employ a competent veterinary surgeon, who shall work under their direction and supervision, and whose compensation shall not exceed the appropriation made for him by law, and who may at any time be discharged by said commissioner and inspector.

Act of 1899 repealed. SEC. 15. *Be it further enacted*, That chapter 424 of the acts of 1899, entitled "An act to amend an act passed March 24, 1897, and approved March 26, 1897, entitled 'An act to reorganize the State board of health of the State of Tennessee,'" be and is hereby repealed.

Act of 1897 repealed. SEC. 16. *Be it further enacted*, That chapter 46 of the acts of 1897, entitled "An act to reorganize the State board of health of the State of Tennessee," be and is hereby amended as follows:

First. By striking out of section 1 the words "one representative live-stock breeder actually engaged in the breeding of live stock."

Second. By striking out of section 2 the words "and one representative live-stock breeder."

Third. By striking out of section 4 the words "the term of office of the representative of the live-stock breeders of the State shall be for six years from date of appointment."

Fourth. By abolishing the office of the live-stock breeder on the State board of health.

SEC. 17. *Be it further enacted*, That this act take effect from and after its passage, the public welfare requiring it.

Approved April 20, 1901.

VERMONT.

AN ACT In amendment of section 4815, chapter 203, of Vermont statutes, relating to the appraisal of animals slaughtered by order of the board of agriculture.

It is hereby enacted by the General Assembly of the State of Vermont:

SECTION 1. Section 4815, chapter 203, of the Vermont statutes is hereby amended to read as follows:

"SEC. 4815. The value of all cattle or other domestic animals, killed by the written order of the board of agriculture, shall be appraised by one of said board and a disinterested person selected by the owner of the condemned animals, but if these two can not agree upon the amount of the appraised value of the animal, they shall select a third disinterested person, who, together with them, shall appraise the animal; such appraisal to be made just before killing, and on a basis of health. The limit of the appraisal of cattle shall be forty dollars ($40.) A postmortem examination shall be made, and, if the animal be found affected with bovine tuberculosis or any disease dangerous to the public health, the owner of the animal shall receive one-half the appraised value; but if no bovine tuberculosis or disease dangerous to the public health be found, the owner of the animal shall receive the full amount of the appraisal, and in addition shall receive the slaughtered animal. The amount which the owner is entitled to receive shall be paid by the State to the owner of such animal or animals upon a written order, signed by the member of the board in charge and countersigned by the secretary of said board. No indemnity shall be paid to the owner of condemned cattle or other domestic animals that have not been owned and kept in the State for at least six months previous to the discovery of the disease, unless such animals have been, at time of importation, duly examined under the regulations of the board and pronounced free from disease."

Penalty. Any person who shall knowingly violate or refuse to comply with any regulations made by such board of agriculture, under the authority and provisions of this section, shall be fined not more than two hundred dollars ($200) or imprisoned not more than two years, or both.

Approved, November 22, 1900

WASHINGTON.

AN ACT To create the office of sheep inspector and prescribe the duties thereof; to prevent the spread of contagious and infectious diseases among sheep; to provide for the collection of damages for the spreading of disease among sheep; and to repeal an act entitled "An act in relation to and to prevent the introduction or spread of disease among sheep, approved February 2, 1888;" and to repeal an act entitled "An act in relation to and [to] prevent the introduction or spread of disease among sheep," approved February 26, 1897, and declaring an emergency.

Be it enacted by the Legislature of the State of Washington:

Appointment of sheep inspector. SECTION 1. The county commissioners of each county in this State may, immediately upon this act going into effect, appoint a qualified person as sheep inspector, for and within the boundaries of their counties, who shall hold office until noon on the second Monday in January, 1903, and until his successor is appointed and has qualified as herein provided; any vacancies by resignation, or otherwise, in said office shall be immediately filled by said county commissioners: *Provided, however*, That the county commissioners of any county may at any time remove said sheep inspector from office and declare the said office vacant, without a hearing or without assigning any cause therefor, for such reasons alone as may cause them to deem it expedient to act in the premises.

Election of successor. SEC. 2. At the regular meeting of the board of county commissioners next prior to the second Monday in January, 1903, said county commissioners may elect a sheep inspector, whose term of office shall begin at noon on the second Monday in January, 1903, and continue for a period of two years, unless sooner removed as hereinbefore provided, and until his successor is elected and has qualified, and said county commissioners shall elect a sheep inspector each two years thereafter at such meeting, who shall from time to time hold office upon the conditions above and herein provided.

Oath and bond. SEC. 3. The sheep inspector before entering upon the discharge of the duties of his office shall take an oath of office, and enter into a bond, with two or more sureties, to be approved by the county commissioners, in

the penal sum of two thousand dollars ($2,000), conditioned for the faithful performance of his duties as such sheep inspector.

Inspector may appoint two deputies. SEC. 4. Such inspector shall have the power to appoint not more than two deputies, for whose acts he shall in all cases be responsible, and by whom he may perform any act or duty required of him by law. Each inspector shall be provided with a seal of office, which shall be inscribed in substance as follows: "Sheep inspector of ——— County, Washington," and each official certificate, notice, or report of such inspector shall be authenticated by such seal.

Quarantine regulations. SEC. 5. Whenever it is shown to the sheep inspector of any county that scab, or scabies, or any contagious or infectious disease is epidemic in certain localities in any county of this State or other State, Territory, province, or country, the said inspector must thereupon designate such locality or localities and prohibit the importation from such locality or localities of any sheep into his county, except under such restrictions as are provided for in this act. This action upon the part of the said inspector shall be known as and shall be deemed to be a quarantine against such locality or localities, and the sheep inspector shall file a notice of such quarantine attested under the seal of his office with the county auditor of his county, who shall provide and keep a book, which shall be properly indexed and open to the public during the office hours of said office, in which said notice shall be transcribed, said book to be designated as the "Sheep Quarantine Register" of said county, and a copy of said notice shall be posted at the front door of the court-house of said county by the said inspector at the time the same is filed with the said auditor, and this shall be deemed to be full notice to all parties concerned of the existence of the sheep quarantine, and it shall be the duty of the inspector to raise the said quarantine when he discovers that the cause for its existence has ceased, and it shall be his duty from time to time to ascertain the condition in the quarantined locality or localities so as to raise said quarantine when he discovers that the cause for its existence has ceased; and upon said quarantine being raised, said inspector shall give notice of its rescission with the county auditor of his county, and post a copy of said notice at the front door of the court-house of said county, and said auditor shall transcribe said notice of rescission in the same book and in the same manner as he has transcribed the notice of the quarantine.

Importers to notify inspector. SEC. 6. Upon notice that a quarantine has been placed on record as hereinbefore provided for against any locality or localities, the owner or person in charge of any sheep which are intended to be brought into the said county from localities quarantined against, as provided in the next preceding section, must forthwith notify the sheep inspector of said county of such intention, and such owner or person in charge shall not allow any sheep from said locality so quarantined against to be brought into the said county doing the quarantining until such sheep have been quarantined and inspected by the sheep inspector as provided in the next succeeding section: *Provided*, That this section shall not apply to sheep being transported upon any railroad or steamer lines through the State of Washington to points beyond the limits of said State, and which are not allowed to graze upon the public range of said State while being so transported.

Inspection before entry into State. SEC. 7. Upon receiving notice of the intention of the owner or person in charge of any sheep, as provided in the last preceding section, to bring such sheep into any county of this State from any quarantined district, the sheep inspector of such county shall forthwith proceed to examine and inspect such sheep before they are brought into the State, and shall cause such sheep to be kept within certain limits designated by him for a period of sixty days, and shall cause the owner or person in charge of such sheep to dip them or otherwise treat them for the disease prevalent in the quarantined district; if at the expiration of said sixty days the said sheep inspector shall find the said sheep are free from scab, or scabies, and all contagious and infectious diseases, he shall issue a certificate to the owner or person in charge of such sheep permitting them to be brought into this State. When the county doing the quarantining is not one of the border counties of this State, and sheep from the quarantined localities have been permitted to be brought into the State by the inspector of the county or counties between said quarantining county and the border of the locality quarantined against, no certificate of the intermediary counties shall be final or binding upon the inspector of the county doing the quarantining, and such certificate shall not permit the owner or person having control of such sheep to bring them into the county quarantining upon such certificate, but in such a case the owner or person in charge of such sheep shall notify the sheep inspector of the county doing the quarantining of his intention to bring said sheep into said county and hold said sheep on the boundary of said county until the sheep inspector of said county shall reach such

sheep, which he shall do as speedily as possible; the said sheep inspector shall then cause such sheep to be kept within certain limits designated by him for a period of sixty days, and shall cause the owner or person in charge of such sheep to dip such sheep or otherwise treat them for the disease prevalent in the quarantined district; if at the expiration of said time the said sheep inspector shall find that such sheep are free from scab, or scabies, and all contagious and infectious diseases, he shall issue a certificate to the owner or person in charge of such sheep permitting them to be brought into his county: *Provided, however,* That if said sheep have been quarantined as provided by this act in any other county in this State after coming into this State, said sheep not having been taken out of the State in the meantime, then the sheep inspector of the county into which the said sheep are to be brought, after satisfying himself that said sheep have been duly and properly quarantined as provided for in this act in such other county or counties, and are in a healthy condition, shall endorse this fact upon the certificate already possessed by the owner or person in charge of said sheep, which shall be deemed to be a certificate from the quarantining county, and shall be sufficient to permit said sheep to be brought lawfully into said county, and to travel therein until revoked or until such sheep become diseased.

Treatment of sheep on entering State.

SEC. 8. Any person who is about to bring sheep into this State from any other State, Territory, province, or country must, before he brings said sheep into this State, notify the sheep inspector of the county in which he intends to first bring said sheep of the fact that he is about to bring said sheep into said county, the section from whence he intends to bring said sheep, and the time, as near as he can tell, when said sheep will arrive in said county. It shall then become the duty of said sheep inspector to be on hand at the time of the arrival of said sheep and inspect the same and cause the same to be confined within certain limits to be designated by him, the said sheep inspector. The said inspector shall also cause the said sheep to be dipped within ten days after the arrival of the said sheep in said county. The said sheep shall be kept within the boundaries prescribed or which may be prescribed from time to time by the said sheep inspector for the period of thirty days after they are dipped, when the inspector shall again inspect the sheep, when he may, in his discretion, if he finds said sheep are diseased or has any reasonable doubts as to the said sheep being in good condition, cause the same to be dipped and treated; and if he deems the same necessary to prevent the scattering of any contagious or infectious disease, he shall require the said sheep to be confined within certain limits for an additional period of thirty days.

Unlawful to move diseased sheep.

SEC. 9. No person shall move or cause to be moved any sheep from any county to another in this State unless said sheep are sound and healthy and free from scab, or scabies, and all infectious and contagious diseases, which condition shall be solely evidenced by a certificate of the inspector, or his deputy, of the county from which said sheep are to be moved, obtained within ninety days immediately preceding such removal.

Inspection by request; certificates.

SEC. 10. It shall be the duty of any sheep inspector, upon the request of any person, to visit and inspect any band of sheep within his county (or within five miles of the line of the State in another State or Territory); and if at the time of such inspection such sheep are healthy and free from scab, or scabies, and all infectious and contagious diseases, said inspector shall cause [issue to] the owner or person in charge of such sheep a certificate to that effect; and if he finds said sheep not healthy and infected with scab, or scabies, or other contagious or infectious diseases, he shall revoke any certificate which may have been issued by him showing such sheep to be in good condition, and such certificate so revoked shall thereafter be null and void and shall be no protection whatever thereafter to the person holding the same, and such person, on demand, shall deliver the same to such inspector forthwith.

Unlawful to import diseased sheep.

SEC. 11. It shall be unlawful hereafter for any person, company, or corporation to bring into this State any sheep infected with the scab, or scabies, or any other infectious or contagious disease, and it shall also be unlawful for any person to bring into this State any sheep which have not been free from all evidence of scab, or scabies, or any contagious or infectious disease for at least three months prior to the time said sheep are brought into the State.

Isolation of diseased sheep.

SEC. 12. Any person owning or having charge of any sheep infected with scab, or scabies, or any infectious or contagious disease shall keep the same and all sheep with which such sheep have been in contact, and the band or herd in which said sheep have been

kept, secure from contact with other sheep and shall not drive or permit the same to go upon any public road or highway or any inclosed or uninclosed land not owned or leased by such person: *Provided*, That such sheep may be moved or driven upon public roads or highways by first obtaining the written permission of the sheep inspector of the county wherein such sheep may be, which permission shall state the time within which such sheep are to be moved, the place to and from which they are to be moved, and the route to be traveled: *Provided*, That nothing contained herein shall be construed as giving any inspector any authority to grant any person any right to herd said sheep or the band or herd with which such sheep have been kept upon any public road or highway or any traveled trail or road.

Duties of inspectors. SEC. 13. It shall be the duty of each sheep inspector to visit and inspect every band of sheep within his county during the months of April or May each year; and at such other times when he is informed in writing, or has reason to believe, that any sheep within his county are infected with scab, or scabies, or any infectious or contagious disease, he shall immediately visit such sheep and inspect the same, and upon request of sheep owners representing at least fifty thousand head of sheep he shall also inspect all the sheep in his county also between the 25th day of August and the 25th day of September of any year when so requested.

Regulations for diseased sheep. SEC. 14. Whenever upon inspection of any band or herd of sheep, or of any sheep, in any county of the State of Washington the sheep inspector of such county shall find any of said sheep affected with scab, or scabies, or other infectious or contagious disease, he shall forthwith notify the owner or person in charge of such sheep, in writing, to put such diseased sheep and the herd, or band, in which they have been kept into an enclosure, or, if such sheep are on the range, to put and keep such diseased sheep and the herd or band in which they have been kept within certain limits, which shall be designated and defined in such notice by reference to natural or artificial objects, and which shall be known and designated in this act as the "sheep quarantine limits," and the inspector shall require the owner or person in charge of such sheep to proceed immediately to treat such sheep and the band, or herd, in which they have been kept for the cure of such disease, by some means approved by the inspector, provided that when a dip is used the dip hereinafter provided for shall be used; and any person who shall neglect for three days after the service of such notice to put such sheep into an enclosure, or within the limits designated by such inspector, or shall refuse or neglect to proceed to treat such sheep for the cure of such disease by a remedy approved by the inspector and herein provided within three days after the time fixed by the inspector, which must be reasonable and give ample time to said party to prepare to dip and treat said sheep, shall be deemed guilty of a misdemeanor; and for each day of such neglect or refusal to comply with the order of said inspector after three days from the date of said notice such person shall be deemed guilty of a separate misdemeanor, and, in addition to the punishment provided for in this act, the inspector shall take charge of such sheep and place them within a proper enclosure or within proper limits and keep them there, and cause them to be treated as directed, and the expense of such siezure, keeping, and treatment, together with the fees of the inspector, shall be a charge on the sheep so seized, and shall be a lien thereon prior to any other lien upon said sheep.

Owners must assist inspectors. SEC. 15. The sheep inspector shall have the authority to corral any sheep which he may desire to examine and the person having charge of such sheep shall, when so requested, assist the said inspector in catching and examining said sheep, and any person being the owner, or in charge thereof, or assisting to care for, any sheep who shall refuse to assist said inspector, when requested as hereinbefore provided, and any person who shall secrete any diseased sheep to prevent the inspector from examining the same, or who shall prevent the inspector from examining any sheep, or in any way interfere with such inspector discharging the duties of his office, shall be deemed guilty of a misdemeanor. Any person who shall drive any sheep or cause any sheep to be driven upon or within the limits set apart for any quarantined sheep by a sheep inspector while the same are being occupied by such quarantined sheep, and any person who shall drive any sheep, or cause any sheep within such quarantine limits to be driven, out of the said quarantine limits shall be deemed guilty of a misdemeanor: *Provided, however*, That the sheep inspector shall not quarantine any sheep within three miles of any shearing corral, except corrals owned by the owners of said sheep or leased by him [them].

Inspector may change quarantine limits. SEC. 16. The sheep inspector shall have the authority, upon written application of the owner or person in charge of any quarantined sheep, to change the quarantine limits of such sheep for the purpose of procuring sufficient feed for such sheep, and to reestablish new quarantine limits, and this may be done from time to time in the discretion of the inspector.

Certificate necessary for travel. SEC. 17. No owner of any toll bridge or ferry boat, or person in charge thereof, shall permit any sheep to cross any bridge or go upon any ferry boat in charge of such person or persons, unless the person in charge of such sheep shall first exhibit to the person in charge of such bridge or boat a valid certificate issued by an inspector appointed under this act, to the effect that such sheep are free from scab, or scabies, or any contagious or infectious disease.

Certificates void after one year. SEC. 18. Every certificate issued under this act to the owner of sheep continuously kept within this State shall be null and void after one year from the date thereof, and every certificate issued to the owner of any band, or herd, of sheep which are not continuously kept within this State during the year which such certificate was issued shall expire upon such sheep being driven out of this State at any time after said certificate has been issued.

Salary of inspectors. SEC. 19. Every sheep inspector and deputy inspector shall be paid five dollars ($5) per day for each day when necessarily engaged in the duties of his office and five (5) cents per mile for each mile necessarily traveled by him for such purpose, and his bills for such purposes shall be audited and paid by the county commissioners of the county from which he was appointed.

Unlawful to drive without certificate. SEC. 20. No person shall drive any sheep or cause any sheep to be driven upon the public roads, upon the public ranges, or traveled trails or roads within this State except as herein provided, unless he has a valid certificate showing that said sheep are free from scab, or scabies, or infectious or contagious disease.

Liability for damages. SEC. 21. Nothing in this act shall be construed as exempting any person owning sheep from liability in a civil action for damages for negligently or carelessly spreading scab, or scabies, or any other contagious or infectious diseases, but any person so spreading or causing said disease to be spread, either personally or through his agents in charge of sheep belonging to him, shall be liable in a civil action for damages sustained by any other person for injury to such other person's sheep by the infecting of such sheep with the scab, or scabies, or any other contagious or infectious disease, the same as if this act had not been passed, and no certificate issued under the provisions of this act shall be any defense or excuse in an action for damages of this character. Any damages that may be recovered in such a civil action for damages shall be a lien upon the sheep infected as stated herein by any other band or herd of sheep, for which infection such suit may have been brought, and the court in rendering judgment in any action brought for such damages shall declare such judgment to be a lien upon such sheep and direct them to be sold under special execution to pay such judgment.

Legal action and attorneys' fees. SEC. 22. The liens herein provided for shall be foreclosed by an action brought in the superior court for the county wherein the lien originated in the name of the said county by the prosecuting attorney for said county as chattel mortgages are foreclosed, by a suit in the superior court, and upon commencing such an action in said court the prosecuting attorney shall immediately move for the appointment of a receiver to take charge of said sheep and keep the same pending the action, and it shall be the duty of the court to appoint such receiver without notice, and all the expenses thereof and all the costs that are taxed in civil actions between individuals shall be taxed up in favor of the county in such a proceeding, and an attorney's fee of fifty dollars ($50) shall be taxed in such a proceeding in addition to the attorney's fee allowed by law in a civil action, and all the said costs and attorney's fees shall be paid into the county treasury and shall be credited to the same fund to which the fees collected by county officers are credited: *Provided*, That the sheep inspector may employ an attorney to assist the prosecuting attorney in such case, when said attorney's fees shall go to such attorney so employed.

Fraud by inspector. SEC. 23. The sheep inspector and his deputies shall in case that they or either of them, or any of them, shall act fraudulently in administering this law, or enter into collusion with any person to evade

it or to avoid the consequences of its violation, shall be deemed guilty of a misdemeanor, and punished as hereinafter provided.

Return of sheep illegally moved. SEC. 24. Sheep brought into any county in this State or moved through the said county without a proper certificate shall be returned under the direction of the sheep inspector to the place from which they were so illegally moved, should the same be in the county where they are found, and if such place should be without the county, they shall be moved to the border of the county where they are so found, and they shall there be held by the sheep inspector until the charges for driving said sheep or conveying said sheep to said point have been paid, including five dollars ($5) per day for the inspector or his deputy while engaged in such work, and such expenses shall be a lien against said sheep, and shall be enforced as other liens herein provided are enforced: *Provided*, That said sheep shall only remain in the hands of the inspector until the appointment of a receiver by the court to take charge of the same, and it shall be the inspector's duty to see that this is done speedily.

Location of quarantine lines. SEC. 25. In establishing the quarantine limits herein provided for the same shall be established only upon the range or land leased or owned by the owner of the sheep or the person in charge thereof, except where the same can be established on public lands of the United States, not the customary range of another, or lands obtained from private parties by their consent, either by the sheep inspector or the owner of said sheep, or the person in charge thereof; and in case it shall become necessary for said sheep to be driven or transported to a place where the same may be quarantined without infringing the rights of others, the sheep inspector shall carefully provide the route to be taken by said sheep and supervise the movement thereof, and see to it that said sheep shall not come into contact with other sheep or near enough to affect them with the scab, or scabies, or any other contagious or infectious disease.

Disease must be reported. SEC. 26. It is hereby made the duty of every sheep owner and of every person having charge of sheep, or herding or working with sheep in any capacity, to report to the sheep inspector of the county where such sheep are located the existence of scab, or scabies, or any other contagious or infectious disease among said sheep as soon as possible after such person has knowledge of the existence thereof, and any such person who fails to give such information to such sheep inspector, or who knowingly or wilfully conceals the existence of such disease or diseases amongst the sheep owned by him, or in his charge, or being herded by him or with which he is working in any capacity, shall be guilty of a misdemeanor, and punished as hereinafter provided.

Penalty.

Constitutionality. SEC. 27. In the event of any part of this act being declared invalid or unconstitutional by any court, the remainder of the act shall be and remain in full force and effect.

Words defined. SEC. 28. The word "person" as used in this act shall include corporations, firms, associations, and companies, as well as individuals, and the words "sheep inspector" or "inspectors" wherever used herein shall be deemed to be used as "sheep inspector" as established in this act, and the word "deputy" or "deputies" shall be deemed to follow the word "inspector" wherever used in this act.

General penalty. SEC. 29. Any person who shall violate this act, or any part thereof, shall be deemed to be guilty of a misdemeanor, and on conviction thereof shall be fined not less than two hundred and fifty dollars ($250) nor more than five hundred dollars ($500), or be punished by confinement in the county jail for not less than thirty days nor more than six months, and for the commission of the acts herein which are specifically declared in various parts of this act to be misdemeanors, aside from the general provisions contained in this section, the person guilty thereof shall be punishable by a fine of not less than fifty dollars ($50) nor more than five hundred dollars ($500), or by confinement in the county jail for not less than ten days nor more than six months.

Laws of 1888 and 1897 repealed. SEC. 30. The act of the legislative assembly of the Territory of Washington approved February 2, 1888, entitled "An act in relation to and to prevent the introduction or spread of disease among sheep," and the act of the legislature of the State of Washington approved February 26, 1887, and entitled "An act in relation to and to prevent the introduction or spread of disease among sheep, and repealing an act in relation to and to prevent the introduction or spread of disease among sheep, approved February 2, 1888, and declaring an emergency," are each hereby repealed, and all other acts and parts of acts in conflict with this act are hereby repealed.

Emergency. SEC. 31. An emergency exists, and this act shall take effect immediately.

Approved March 16, 1901.

AN ACT To amend sections 2 and 5 of an act entitled "An act providing for the creation of the office of the State veterinary surgeon and defining his duties," approved March 22, 1895.

Be it enacted by the Legislature of the State of Washington:

Duties of State veterinarian. SECTION 1. That section 2 of an act approved March 22, 1895, entitled "An act providing for the creation of the office of the State veterinary surgeon and defining his duties," be, and the same is hereby, amended to read as follows:

"SEC. 2. He shall have general supervision of all contagious and infectious diseases among domestic animals within or that may be in transit through the State, and he is authorized and empowered to inspect and test all cattle within the State for tuberculosis whenever in his judgment it is deemed advisable, and he is empowered to establish quarantine against any and all such animals affected with any contagious or infectious disease or diseases, or that have been exposed to others thus diseased, whether within or without the State; and he may, with the concurrence of the State board of health, make such rules and regulations as he may deem necessary for the protection against the spread and for the suppression of said disease or diseases, which rules and regulations, after the concurrence of the governor, shall be published and enforced, and in doing said things, or any of them, he shall have the power to call on any one or more peace officers, whose duty it shall be to give him all the assistance in their power."

Destruction of diseased animals. SEC. 3. That section 5 of said act be amended to read as follows:

"SEC. 5. Whenever in the opinion of the State veterinary surgeon the public welfare demands the destruction of any diseased animal under the provisions of this act, he shall cause the same to be destroyed. No stock shall be destroyed except on the written order of the State veterinary surgeon. The governor of the State, with the State veterinary surgeon, may cooperate with the Government of the United States for the object of this act, and the governor is hereby authorized to receive and receipt for any money receivable by this State through provisions of any act of Congress which may at any time be in force upon this subject, and to pay the same into the State treasury to be used according to the act of Congress and the provisions of this act."

Approved March 16, 1901.

WEST VIRGINIA.

AN ACT To prevent the introduction and spread of contagious diseases among domestic animals.

Be it enacted by the Legislature of West Virginia:

That chapter fifty-three of the acts of one thousand eight hundred and ninety-nine be amended and reenacted and additional section added thereto, so as to read as follows:

Quarantine regulations. 1. That when it shall be brought to the notice of the secretary of the board of agriculture that any contagious or infectious disease not otherwise provided for by law prevails among domestic animals, he shall take such measures to prevent its spread as may be deemed expedient, and for this purpose shall give written instructions or permits to one or more of his consulting veterinarians of the State board, giving him or them power to place infected animals, herds, buildings, lots, and farms in quarantine and to prevent the movement of animals or objects likely to carry the contagion, except on proper permits by one or more of the said consulting veterinarians.

Veterinarian to report. 2. All the work of the veterinarians shall be promptly and fully reported to the secretary on such blanks and forms as he may supply, and with the consent and approval of the board, and such rules and regulations for the government of such quarantine as may be deemed necessary to effectively carry out the provisions of this act may be adopted and enforced.

Penalty for violation. 3. That any person, persons, or corporation who shall fail to report to the said secretary any importation of any domestic animals for breeding purposes into this State, or who shall wilfully or intentionally interfere with any officer or officers authorized to carry out the provisions of this act, or who shall wilfully or intentionally violate the provisions of the quarantine authorized in this act, shall be deemed guilty of a misdemeanor, and upon conviction shall be liable to imprisonment of not exceeding three months, or a fine not exceeding one hundred dollars ($100), or both, at the discretion of the court.

Inspection of herds. 4. That it shall be the duty of the said consulting veterinarian, under the direction and control of the secretary, to visit once a year, at such time as the secretary may direct, and examine, and, if deemed necessary, test in a proper manner all thoroughbred herds of twenty or more within this State which are kept for the purpose of producing animals for breeding purposes and to be sold to the public as such. Should the veterinarian making the examination find such animals free from any contagious or infectious disease, he shall issue to the owner or owners a certificate stating that fact. Should he find any contagious or infectious disease prevailing, he shall then proceed as authorized in section seven of this act. It shall further be the duty of said consulting veterinarian, under the same direction and control, to visit annually, at such time as the secretary may direct, and inspect, and, if deemed necessary, thoroughly test all dairy herds of ten or more cows within this State, the products of which are sold to the public. Should the animals prove to be free from any contagious or infectious disease, said veterinarian shall issue to the owner or owners of such herd a certificate to that effect. Should any of the animals prove to be affected with tuberculosis or any other disease of a dangerous nature, it shall then be the duty of said veterinarian to proceed as authorized in section seven of this act.

Charges of veterinarian. For such services as are not prescribed for in this act said consulting veterinarian shall receive a per diem of four dollars ($4) per day for actual time of service, which shall be paid by the owner or owners of animals that are examined. The actual traveling and other expenses incurred by said veterinarian shall be paid by the State board of agriculture out of current appropriations for the purpose, on an order signed by the president and secretary of the said board. Full and complete reports of all services performed by the veterinarian shall be promptly made to the said secretary, on such blanks as he may supply and in such form as he may require.

Cases to be reported. 5. That it shall be the duty of the consulting veterinarians having cases in charge to report the same fully and promptly to the said secretary, in such form as he may prescribe.

Powers of veterinarian. 6. That when in the judgment of the secretary of the board public interest and safety demand it, he may give written authority to any consulting veterinarian of the board, who shall be a graduate of some reputable veterianary college, to examine any animal or animals or any buildings or farms suspected, and the decision of such veterinarian, after proper examination and under the provisions of this act and such rules and regulations as the board may prescribe, shall be final, and said veterinarian may proceed to quarantine, to destroy, to order burned or buried, or to take any other action authorized by this act and the rules of said board.

Compensation. For such services the veterinarian shall receive a per diem of four dollars ($4) per day and actual expenses while engaged, which shall be paid out of the current appropriations made for the enforcement of this act and on an order signed by the president and secretary of the board.

Appraisements. 7. That when it shall be found necessary or expedient to kill any animal or animals to prevent the spread of contagious or infectious diseases, it or they shall first be appraised by three disinterested and sworn appraisers, who shall have due consideration of the actual condition of the animal or animals at the appraisement, and the owner or owners of such animal or animals so destroyed shall be entitled to receive from the secretary of the board of agriculture a certificate of value, as appraised by said appraisers, subject to the consent and approval of said board. For such services each appraiser shall receive a per diem of one dollar ($1) per day, to be paid out of current appropriations made for the enforcement of this act and on an order signed by the president and secretary of the said board.

Payment for animals slaughtered. 8. That at the end of each fiscal year the holders of such certificates of value shall be paid the same from the current appropriations made for the purpose: *Provided*, That the amount to be paid on such certificates in any one year shall not exceed the sum of five thousand dollars ($5,000), which amount shall be paid pro rata at the end of each fiscal year, on an order signed by the president and secretary of the State board of agriculture.

Cooperation with United States Government. 9. That for the economical eradication of contagious or infectious diseases of domestic animals the secretary of the State board of agriculture shall have power, with the approval and consent of said board, to arrange for and carry into effect terms of cooperation with the proper officers of the National Government.

Repealing clause. 10. That all acts or parts of acts inconsistent herewith are hereby repealed.

Passed February 21, 1901. In effect ninety days from passage.
Approved February 22, 1901

WISCONSIN.

AN ACT For the establishment of a live-stock sanitary board.

The people of the State of Wisconsin represented in Senate and Assembly do enact as follows:

Constitution of board. SECTION 1. There is hereby constituted a State live-stock sanitary board, which shall consist of three members of the State board of agriculture, to be chosen by that body from its membership, the bacteriologist of the State agricultural college, and the State veterinarian; the last two mentioned members to be ex officio members of the board, and the State veterinarian to serve without additional compensation. The members selected from the State board of agriculture shall hold office for a term of three years, except that the member first chosen shall hold his position for one year, the second for two years, and the third for three years from the first day of June, 1901.

Compensation of members. They shall serve without salary, but shall be paid three dollars ($3) per day, and all members of the board shall be paid their actual expenses when in the discharge of their duties. Meetings of the board shall be limited to twelve in each year, and the service of no member on said board, for which a per diem is paid, shall exceed thirty days in any one year. The board may organize by the election of a president and secretary and shall hold its office in such room in the capitol as the governor may designate.

Duties of board. SEC. 2. It shall be the duty of the State live-stock sanitary board to protect the health of domestic animals of the State; to determine and employ the most efficient and practical means for the prevention, suppression, control, or eradication of dangerous, contagious, or infectious diseases among domestic animals; and for these purposes it is hereby authorized and empowered to establish, maintain, enforce, and regulate such quarantine and other measures relating to the movement and care of animals and their products, the disinfection of suspected localities and articles and the disposition of animals, as it may deem necessary, and to adopt from time to time all such regulations as may be necessary and proper for carrying out the purposes of this act: *Provided, however*, In the case of slowly contagious diseases, only suspected or diseased animals shall be quarantined, and in case of bovine tuberculosis or actimonycosis, the owner shall be granted the option of retaining the animals in quarantine, under such restrictions as the board may prescribe.

Slaughter and appraisement of animals. SEC. 3. Whenever the owner shall not exercise option and it shall be deemed necessary by the board to slaughter diseased animals, written notice shall be given to the owner, his agent, or the person in charge of such animals, and to a justice of the peace in the county in which the animals may be, of the purpose to order the slaughter thereof, giving the number and description of the animals and the name of the owner, if known. Such notice shall be entered on the docket of such justice, who shall immediately thereafter summon such owner, agent, or possessor, and also three disinterested citizens of the county, not residents of the immediate neighborhood in which such animals are owned or kept, to appraise the value

thereof. Such appraisers shall, before entering upon the discharge of their duties, be sworn by such justice to make a true appraisement without prejudice or favor of the value of such animals, and they shall certify in their return that they have seen the appraised animals slaughtered. In making appraisement of diseased animals the appraisers shall determine their value in the condition in which they are found at the time of appraisement; but the appraised value of no single animal shall exceed fifty dollars ($50). If such appraised animals are slaughtered, said slaughter shall be made under the direction of the local health officer or the chairman of the town board. The owner of slaughtered animals shall receive no compensation for the same until the live-stock sanitary board is satisfied that the infected premises have been disinfected in such a manner as to prevent the further spread of disease.

Importations may be prohibited. SEC. 4. Whenever the State live-stock sanitary board shall have reason to believe that there is danger of the introduction into this State of any contagious or infectious disease prevailing among domestic animals in any district outside this State, or its dissemination from one district in this State to another, it shall investigate the existing conditions, and if it conclude that danger exists to the live-stock interests of this State therefrom, it may, with the advice and consent of the governor, prohibit the importation of animals of the kind diseased from the infected district into this State, or the moving of them from one part of the State to another, except under such regulations as the board may establish.

Owners must report disease. It shall be the duty of every person who shall have reason to suspect that there is upon his premises, or upon the premises occupied by him, or under his control, any domestic animal having a contagious or infectious disease, to immediately report the fact to the local board of health or some member of the same, who shall immediately report such case to the State veterinarian or the secretary of the board. The board or State veterinarian may require the owner of suspected stock to employ at his own expense a qualified veterinary surgeon to examine such stock and determine whether, in his opinion, the disease exists.

Premises may be entered. This board or any member thereof may enter upon any premises or go into any building or place where he has reason to suspect there may be diseased animals and examine the same, and may call to his aid, if necessary, the sheriff or any constable of the county in which such animals may be located; and all such officers when so called upon shall assist such board or member thereof in the enforcement of the provisions of this act. Animals in transit in the State are hereby declared to be under the provisions of this act.

Claims for slaughtered animals. SEC. 5. All claims against the State arising from the slaughter of animals, as above provided, shall be made by filing with the secretary of state a copy of the State veterinarian's notice to the justice of the peace, and the return of the appraisers to the justice, which notice and return shall be certified by him. The secretary of State shall examine these, and if satisfied that the amount awarded is just and that the owner of the animals slaughtered is entitled to indemnity, shall issue his warrant for two-thirds of the sum named in such return; but if he shall have reason to believe that the appraised value is greater than the real value of such animals he shall pay such owner such less sum as he may deem just: *Provided*, That the right to indemnity shall not exist nor shall payment be made in either of the following cases: First, for animals owned by the United States, this State, or any county, city, town, or village in this State; second, for animals brought into this State contrary to the provisions of this act, or where the owner of the animal or the person claiming compensation has failed to comply with the provisions of the same; third, when the owner or claimant, at the time of coming into possession of the animal knew, or had good reason to believe, it to be afflicted with a contagious or infectious disease; fourth, when the animal slaughtered was diseased at the time of its arrival in this State; fifth, when the owner shall have been guilty of negligence or has wilfully exposed such animal to the influences of a contagious or infectious disease.

Allowance for experiments. SEC. 6. The State live-stock sanitary board shall be allowed, for experimental purposes, with the consent and approval of the governor, a sum not to exceed five hundred dollars ($500) annually, which bills of expenditure shall be audited and approved by the governor. It shall from time to time issue such bulletins of information as it may deem advisable, which, with the report of the board to be made to the governor in October of each year, shall be printed by the commissioners of public printing, the bulletins in such number as the governor may approve, and one thousand copies of the report of this board, five hundred of which shall be bound.

Assistant veterinary surgeons. The State veterinarian is hereby authorized to call to his assistance, as may be necessary in the performance of his work, duly qualified veterinary surgeons, who shall be paid for their services at the rate of seven dollars ($7) per day and their actual expenses for the time they are actually employed as assistants. Their accounts shall be audited upon itemized vouchers, certified to by the State veterinarian and approved by the governor; but no person shall be considered a veterinary surgeon within the meaning of this act who is not a regular graduate in good standing of some recognized veterinary college in the United States, Canada, or Europe.

Compensation for appraisers, etc. The appraisers herein provided for shall receive two dollars ($2) for each day actually employed as such, which amount shall be paid out of the county treasury, upon the certificate of the justice by whom they were summoned. The justice of the peace and other officers who may perform any duty hereunder shall have the same fees as are allowed by law in criminal proceedings in justice courts, and shall be paid by the county in which their services are performed.

Office supplies. SEC. 7. The superintendent of public property is hereby instructed to furnish the State live-stock sanitary board with the necessary stationery and postage stamps for its work.

Repealing clause. SEC. 8. All acts and parts of acts inconsistent with the provisions of this act are hereby repealed.

SEC. 9. This act shall take effect and be in force from and after June first, 1901.

Approved May 15, 1901.

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U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF ANIMAL INDUSTRY—BULLETIN NO. 44.

D. E. SALMON, D. V. M., Chief of Bureau

INFECTIVENESS OF MILK OF COWS WHICH HAVE REACTED TO THE TUBERCULIN TEST.

BY

JOHN R. MOHLER, A. M., V. M. D.,

CHIEF OF PATHOLOGICAL DIVISION, BUREAU OF ANIMAL INDUSTRY.

WASHINGTON:

GOVERNMENT PRINTING OFFICE.

1903.

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
Washington, D. C., January 2, 1903.

SIR: I have the honor to transmit herewith a manuscript concerning the "Infectiveness of milk of cows which have reacted to the tuberculin test," by Dr. John R. Mohler, Chief of the Pathological Division of the Bureau. The work herein recorded deals with tuberculosis and the tuberculin test in a herd of cattle at St. Elizabeth Asylum, District of Columbia. I recommend that the manuscript be published as Bulletin No. 44 of this Bureau.

Respectfully,

D. E. SALMON, *Chief of Bureau.*

Hon. JAMES WILSON, *Secretary.*

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INFECTIVENESS OF MILK OF COWS WHICH HAVE REACTED TO THE TUBERCULIN TEST.

By JOHN R. MOHLER, A. M., V. M. D.,
Chief of Pathological Division, Bureau of Animal Industry.

PRELIMINARY NOTES.

During March and April of 1900 a highly fatal disease appeared among the cattle in the dairy herd belonging to the Government Asylum for the Insane at St. Elizabeth, D. C. Six or seven dry cows died in the course of a few days after exhibiting symptoms which pointed to the central nervous system as being the site of the principal disturbance. A number of other cows became similarly affected, and in the course of two weeks from the beginning of the outbreak eighteen animals had died, when the disease suddenly stopped.

None but dry cows became affected, and the fact that these animals had been kept in a small pasture some distance from the barns where a supposedly rabid dog had been seen among them five weeks before indicated that the disease might be rabies. The pronounced cerebral symptoms—that is, extreme irritability and nervousness, champing of the jaws, excessive frothing at the mouth, paralysis of the pharynx, and wild expression of the eyes—in connection with a noticeable alteration in the voice, and in two cases pronounced paralysis of the hind quarters, seemed to confirm the above diagnosis. Consequently a number of rabbits were inoculated intracerebrally with oblongata emulsion from four of the affected cows, and, with a single exception, all of these rabbits died with characteristic symptoms of paralytic rabies.

The postmortem examination of the eighteen cows in question revealed the fact that tuberculosis prevailed to a great extent in the herd, as at least twelve of the dead animals showed extensive tuberculous lesions. As a result of this it was considered desirable to have the entire herd examined for tuberculosis, and the Bureau of Animal Industry was requested to submit the cattle to the tuberculin test.

This investigation was referred to the Pathological Division of this Bureau, and arrangements were made without delay to carry it into effect. The following report deals with tuberculosis in this herd and not with rabies.

HISTORY AND CARE OF THE HERD.

Owing to the absence of any regularly kept herd book, no accurate knowledge could be obtained regarding the formation of the herd previous to 1865, when it consisted of 1 Jersey bull and 10 Jersey or Jersey grade cows. During that year 3 registered Jerseys—1 bull and 2 cows—were purchased in Pennsylvania, and the herd was gradually increased by raising the heifer calves until it numbered about 40 cows in 1875.

In 1878, 1 bull, 3 cows, and 6 heifers, all full-blood Ayrshires, were purchased from William Lindsay, of New Jersey, for the purpose of eliminating some of the Jersey blood, it being thought that the addition of this more vigorous stock would give better stamina to the herd. Such Jerseys as appeared weak and unthrifty were gradually weeded out and only apparently healthy Jersey cows were permitted to breed. The Ayrshire blood gradually replaced much of the Jersey strain until in 1885, by natural increase and by purchase of grade cows in Virginia and Maryland, the herd consisted of 100 milch cows, 50 heifers, and 3 bulls—2 Ayrshires and 1 Jersey. At this time it was considered one of the best-bred and best-producing herds in this section and was generally admired.

Early in 1888 the Jersey portion of the herd was increased by 7 full-blood cows purchased in Maryland.

On August 28, 1888, a further addition of the Ayrshire blood was made, as the original stock purchased in 1878 seemed to be decreasing and a new strain was thought desirable. Hence 1 bull and 7 cows, all full-blood Ayrshires, were purchased in Meadville, Pa., and from this nucleus originated the large number of Ayrshires which were in the herd in 1900, the Lindsay strain of Ayrshires having practically disappeared.

A departure from the Ayrshire-Jersey cross was made in March, 1890, when a Holstein-Friesian herd, consisting of 1 bull, "Shadeland Ruby's Duke," and 8 registered cows, were purchased.

This accession made quite an impression upon the herd, and during the next ten years the Jersey blood almost disappeared, until in 1900 the herd was nearly one half grade Holstein-Friesians, the other half Ayrshire and grades. On April 9, 1892, the late superintendent purchased 28 milch cows from a dairy farm at Whaylan, Mass.

When these cows arrived they were weak and unthrifty, and many of them were emaciated and had persistent coughs. The dairy attendants thought they had contracted the coughs en route, as they were on the cars for seven days, and during this period the weather was bleak. In the fall of 1892 four of these cows died, the history being that they coughed badly and gradually wasted away. Several of the

other cows of this purchase did not thrive, and it is the general supposition that tuberculosis was introduced with this stock.

Occasional deaths among the cattle occurred from the causes usually found on all large dairy farms, and Dr. Blackburn, pathologist of the hospital, has held postmortems on many of these carcasses, but no tuberculous lesions were observed until the outbreak of rabies in 1900.

STABLING.

Two large frame barns were used in which to stable the cattle; the smaller one, known as the dry barn, contained those that were advanced in pregnancy, while the larger one held the milking cows.

The lines of stalls in both stables were so arranged that the cattle faced each other, although in the large barn the distance between them was no less than 7 feet, and in the smaller barn, which contained but two rows of stalls, the runway separating them was over 15 feet wide. In the large barn were two double lines of stalls extending the length of the building. A passageway bisects these lines in such a manner as to make eight rows composed of sixteen cows each. A long continuous manger was in front of each row, from which the cows received their feed, and in winter their water also. The cattle were chained to posts running from floor to ceiling, but were not separated from each other in any way. They could eat each others' food, lick one another—in fact, were in intimate contact. It can readily be seen how a disease brought in by infected animals could be disseminated promiscuously to the adjoining cows of the same line through this system of stabling.

Owing to the absence of sufficient pasture in the vicinity, these animals were stable fed all the year. In the mild season the cows were allowed the freedom of an adjoining lot from 7 a. m. until 2 p. m., when they were stabled for the afternoon's milking, and remained in the barn until morning. During the winter season, if the weather permitted, they were turned out for exercise in the morning.

The feed consisted of the usual dairy ration, containing wheat bran, corn meal or rye middlings, and cut timothy hay, dampened before feeding. Sown forage corn was fed liberally to the cattle during the summer and corn fodder in the winter.

TUBERCULIN-TEST RECORD OF THE ST. ELIZABETH HERD INJECTED AT 10 P. M., MAY 2, 1900.

Temperatures of the 12 cows slaughtered at Benning, D. C., June 15, 1900, before the milk experiment was made.

Number of cow.	Temperature taken.	6 a. m.	9 a. m.	12 m.	3 p. m.	6 p. m.	9 p. m.
No. 410	May 2	102.0	102.3	101.6	102.0	102.8	.....
	May 3	102.8	105.0	105.1	106.6	105.4	.....
No. 401	May 2	101.6	101.4	101.1	101.3	102.2	.....
	May 3	102.2	104.6	103.8	103.2	104.5	.....
No. 417	May 2	100.7	101.1	100.8	100.4	102.3	.....
	May 3	102.6	104.6	106.3	106.1	104.2	.....
No. 376	May 2	101.5	101.1	100.4	100.2	101.1	.....
	May 3	105.0	103.1	105.8	105.1	104.0	.....
No. 355	May 2	101.4	101.3	101.6	102.0	101.6	.....
	May 3	105.0	105.4	106.8	105.2	104.4	.....
No. 958	May 2	100.1	101.2	101.0	101.9	101.2	.....
	May 3	100.8	101.9	104.0	104.5	104.8	.....
No. 393	May 2	102.1	102.1	102.1	102.1	102.2	.....
	May 3	102.6	103.6	106.0	106.0	104.9	.....
No. 963	May 2	100.2	101.2	100.4	101.6	102.0	.....
	May 3	101.2	101.9	101.5	103.2	103.6	102.5
No. 356	May 2	101.4	102.2	101.8	102.0	102.0	.....
	May 3	107.8	104.5	106.3	104.8	104.2	.....
No. 383	May 2	105.8	106.4	106.0	106.6	106.4	.....
	May 3	(a)	(a)	(a)	(a)	(a)	(a)
No. 352	May 2	101.6	101.4	101.5	101.6	101.8	.....
	May 3	102.0	102.0	105.0	106.0	104.1	.....
No. 942	May 2	100.2	101.5	102.0	101.2	102.4	.....
	May 3	101.6	106.2	106.2	106.2	105.2	.....

a Not injected.

For postmortem notes on above cattle see page 11.
For the tuberculin records of the 56 cattle which were in the milk experiment, see pages 26 to 78, inclusive.

Record of the temperatures of the remaining cows in the first tuberculin test.

REACTING COWS.

Number of cow.	Temperature taken.	6 a. m.	9 a. m.	12 m.	3 p. m.	6 p. m.
No. 21	May 2	100.8	101.1	101.5	102.9	101.8
	May 3	104.4	104.0	105.8	105.1	105.3
No. 22	May 2	100.6	101.4	101.4	101.7	101.1
	May 3	101.4	102.8	103.6	105.6	104.3
No. 23	May 2	100.3	101.6	101.1	101.4	102.4
	May 3	102.0	103.0	104.9	105.0	105.3
No. 24	May 2	100.6	100.9	102.0	101.8	102.5
	May 3	101.9	101.0	104.6	104.4	103.3
No. 25	May 2	100.9	100.6	101.7	101.8	101.7
	May 3	102.8	104.1	105.0	105.2	104.0
No. 26	May 2	100.3	100.9	101.0	101.4	102.7
	May 3	105.3	107.4	106.2	105.9	105.6
No. 27	May 2	100.6	101.0	101.7	101.3	102.2
	May 3	104.5	106.5	105.9	105.0	104.3
No. 28	May 2	101.0	101.1	101.4	102.2	102.2
	May 3	103.8	104.0	106.6	104.0	103.0
No. 29	May 2	101.7	101.6	101.8	102.7	103.5
	May 3	106.4	104.4	106.6	105.7	103.6
No. 30	May 2	101.6	100.2	100.0	101.0	101.2
	May 3	106.7	104.2	103.2	104.0	102.4

On account of being dry these cows were not used in the investigation of the infectiousness of milk. Their numbers were given subsequent to the tuberculin test.

Record of the temperatures of the remaining cows in the first tuberculin test—Continued.

NONREACTING COWS.

Number of cow.	Temperature taken.	6 a. m.	9 a. m.	12 m.	3 p. m.	6 p. m.
No. 359	May 2	101.4	101.0	101.6	101.8	102.6
	May 3	102.2	100.0	101.4	101.4	101.2
No. 360	May 2	101.1	101.2	102.0	102.0	102.2
	May 3	101.3	100.6	101.2	101.2	101.3
No. 361	May 2	101.6	101.6	101.2	101.8	102.6
	May 3	102.8	100.0	101.7	101.6	102.2
No. 362	May 2	101.8	101.8	102.0	102.2	103.0
	May 3	102.2	100.6	101.2	101.3	101.4
No. 363	May 2	102.2	101.8	102.2	102.6	103.0
	May 3	102.5	101.2	102.0	102.2	102.3
No. 364	May 2	101.2	101.2	102.4	102.0	102.3
	May 3	101.8	100.4	102.2	101.6	101.3
No. 365	May 2	101.4	101.6	102.0	101.8	102.7
	May 3	101.4	100.1	101.0	101.4	101.4
No. 366	May 2	101.5	101.2	102.0	101.6	103.2
	May 3	101.7	100.3	101.2	101.2	103.0
No. 367	May 2	101.0	100.8	101.4	102.0	102.4
	May 3	101.2	100.0	102.2	101.2	101.4
No. 368	May 2	100.8	101.0	102.2	102.0	102.0
	May 3	102.3	100.2	101.2	101.8	101.4
No. 369	May 2	101.4	101.6	101.8	101.6	102.6
	May 3	101.6	101.3	102.3	101.8	101.2
No. 370	May 2	101.8	101.6	102.0	102.4	103.4
	May 3	103.0	100.0	101.0	102.8	102.3
No. 371	May 2	101.4	101.8	103.0	103.4	103.5
	May 3	103.6	103.2	103.2	103.4	103.2
No. 373	May 2	101.3	100.4	100.4	100.4	101.0
	May 3	101.6	100.2	101.6	103.0	102.4
No. 379	May 2	101.9	101.8	101.6	101.8	102.0
	May 3	101.6	101.0	101.7	101.0	101.9
No. 380	May 2	102.0	101.6	101.8	101.6	101.8
	May 3	102.6	101.2	102.6	102.6	102.6
No. 381	May 2	100.6	100.8	101.1	102.8	103.6
	May 3	102.1	101.4	102.8	103.1	102.4
No. 384	May 2	101.5	100.6	101.0	101.1	100.8
	May 3	102.0	101.8	102 0	101.9	101.4
No. 419	May 2	101.0	100.8	101 3	101.3	102.1
	May 3	102.2	102.2	102 8	102.3	102.2
No. 421	May 2	102.0	104.9	102.9	104.0	103.6
	May 3	(a)	(a)	(a)	(a)	(a)
No. 938	May 2	100.8	101.1	101.4	101.8	101.6
	May 3	101.7	101.9	102.0	102.5	103.3
No. 940	May 2	100.6	100.8	101.2	101.7	101.1
	May 3	100.8	101.6	102.7	103.0	102.2
No. 944	May 2	101.7	101.2	101.6	102.2	103.4
	May 3	103.0	102.4	102.0	102.6	103.3
No. 954	May 2	101.3	101.2	101.2	101.2	102.2
	May 3	101.7	101.3	102.0	101.9	103.0
No. 959	May 2	102.2	102.0	101.8	102.0	102.2
	May 3	101.4	101.0	101.5	102.1	102.1
No. 960	May 2	101.7	102.2	102.0	101.8	102.4
	May 3	101.8	102.4	103 2	103.0	103.0

a Not injected.

RESULT OF FIRST TUBERCULIN TEST.

On May 2 and 3, 1900, the herd, then consisting of 104 head, was tested with tuberculin. Only 2 cows, which showed excessive temperatures previous to the injection, were excluded from the test. One of these was nearing parturition, while the other was affected with

traumatic pericarditis caused by the penetration of a foreign body (piece of baling wire) from the reticulum through the diaphragm to the pericardium, and on account of this condition was one of the first 12 to be slaughtered without being tested. Of the remaining 102 head, 76 gave a decided reaction (see table, p. 8), while one cow, No. 953, showed a questionable rise, making the proportion of animals affected more than 74 per cent. Of the 25 animals which did not react, 13 had but recently been purchased from a farm in Virginia and had been kept in one line by themselves in a corner of the barn during the two weeks they had been in the asylum stables. They consequently served as an excellent check on the results of the tuberculin tests. If these 13 animals are excluded, it will be seen that more than 85 per cent of the old herd was tuberculous.

These results demonstrated beyond a doubt that radical measures must be taken at once in order to prevent the infection of the healthy animals, and especially to eliminate those which, on physical examination, were found to be affected with any of the forms of tuberculosis which are especially dangerous for the dissemination of the disease—that is, cavernous tuberculosis of the lungs, tuberculous ulcers of the intestines, tuberculous metritis, and tuberculosis of the udder.

In justification of the superintendent of the farm and barns it should be mentioned that the general appearance of the entire herd was not such as to lead a layman to suspect the extent to which the disease had spread among the animals. In fact, a physical examination of all the animals led to the selection of only 12 head for immediate destruction, and some of these were condemned principally on the testimony of the superintendent to the effect that they had recently begun to fall off to a marked degree or were of no further use to the dairy. A number of these animals were affected to such an extent that their continuation in the stable would mean a continued loss, since their yield of milk in no way corresponded to the cost of their keep, while, on the other hand, their presence in the stable would be a constant source of infection for the other animals. They were, therefore, taken to the public slaughterhouse at Benning, D. C., and destroyed on June 15, 1900. Ten of these animals had reacted to the tuberculin test; 1 (No. 383) was selected owing to the development of symptoms of traumatic pericarditis, while the twelfth cow (No. 953) was the one previously referred to that had shown the only suspicious rise of temperature not considered sufficiently definite to warrant her condemnation. By the test record (p. 8) it is seen that her highest temperature subsequent to the tuberculin injection was 103.6°, a rise of but 1.6° above normal. It was questionable whether this should be regarded as a reaction, and it was decided that the proper course would be to hold her for retest. However, owing to her general unthriftiness and the presence of chronic mastitis, which made the animal unfit for dairy purposes, she was destroyed at once.

A careful postmortem examination showed that the 10 reacting animals were affected with tuberculosis to a greater or less extent, while the cow giving the questionable rise of temperature showed only three encapsulated tuberculous centers, the size of hemp seeds, in one of the mesenteric glands. This gland was removed for the purpose of inoculating the tuberculous material into guinea pigs in order to test its virulence, but unfortunately it was mislaid in collecting the specimens to be brought to the laboratory. Of the 10 reacting cows 5 were found to be unfit for food, while the tuberculous alterations in the other 5 were confined to the lymph glands or else localized in such a way as to admit of complete excision and the passing of the carcasses for food. The cow which failed to give a precise reaction was also passed, while the twelfth cow (No. 383) was condemned owing to the presence of both tuberculosis and traumatic pericarditis.

A brief description and postmortem report of these cattle follow:

No. 410. Holstein raised on farm; 6 years old; delicate and unthrifty in appearance; glands apparently normal on examination; right lung slightly affected; bad cough; weight, 750 pounds.

Postmortem.—Miliary tubercles throughout both lungs, more numerous in caudal lobe of right lung. All mesenteric glands enlarged, some being as large as a hen's egg, and show various degrees of tuberculous degeneration. Fresh tubercles on peritoneal covering of liver.

Carcass condemned.

No. 401. Common stock; 7 years old; bought six months ago; in fair condition; becoming unthrifty; appetite poor; no milk; not wanted by farm superintendent; weight, 850 pounds.

Postmortem.—One small nodule the size of a pea in right ventral lobe of lung. Posterior mediastinal glands greatly affected and calcareous.

Carcass passed.

No. 417. Blue-spotted, common stock; 8 years old; bought three years ago; delicate; capricious appetite; thin condition; not wanted in herd; weight, 790 pounds.

Postmortem.—A few small encapsulated foci in both lungs. Both retropharyngeal glands the size of hens' eggs, and containing thick yellow pus. Right supramammary lymph gland greatly enlarged, but contains no tuberculous focus.

Carcass passed.

No. 376. Yellow, common stock; 7 years old; bought five years ago; in poor condition and becoming unthrifty; physical signs of tuberculosis present; sibilant râles; weight, 660 pounds.

Postmortem.—Extensive tuberculosis of both lungs. Bronchial and mediastinal glands all enlarged and completely degenerated. Both retropharyngeal glands the size of a hen's egg, containing pus. One mesenteric gland is swollen and contains a caseous tuberculous mass.

Carcass condemned.

No. 355. Grade Jersey; 14 years old; raised; losing flesh despite good appetite; left submaxillary gland enlarged; numerous râles distinctly heard in both lungs; weight, 660 pounds.

Postmortem.—Both lungs contain numerous nodules throughout the parenchyma, with two or three abscesses opening into bronchi. Extensive tubercular pericarditis and pearly disease of the pleura. Bronchial and mediastinal glands completely broken down. Left submaxillary gland and both retropharyngeal glands are enlarged and contents degenerated. Entire chain of mesenteric glands are extensively involved.

Carcass condemned.

No. 958. Jersey grade; 5 years old; bought two years ago; dry and not with calf; no use for dairy; weight, 775 pounds.

Postmortem.—Numerous small tuberculous foci in ventral and cephalic lobes of right lung. Mesenteric glands normal. Several abscesses in liver about 2 inches in diameter, but not of tuberculous nature.

Carcass passed.

No. 393. Grade Ayrshire; 9 years old; bought five years ago; in poor condition; physical symptoms apparent; weight, 950 pounds.

Postmortem.—The cephalic lobes of both lungs contain broken-down nodules and one large focus containing pus is seen in the right ventral lobe. Right bronchial gland normal in size, but presents a tubercular focus. Entire mesenteric chain affected; areas not very large, but numerous and calcareous. Supramammary gland as large as a duck's egg and watery, but did not show tubercle bacilli in cover-glass preparations.

Carcass condemned.

No. 953. Red grade; 7 years old; bought one year ago; chronic mastitis in one quarter of udder; poor feeder and in thin condition; not wanted by farm superintendent; weight, 675 pounds.

Postmortem.—Three small, well-defined foci the size of hempseeds in one of the mesenteric glands.

Carcass passed.

No. 356. Ayrshire grade; 10 years old; bought five years ago; very poor condition; shows typical signs of tuberculosis; weight, 725 pounds.

Postmortem.—Caseous tubercular area in posterior and lower portion of main lobe of right lung. Cephalic lobe consists almost entirely of a soft caseous mass. Left lung contains tuberculous nodules with calcareous centers in upper and posterior portion of main lobe. Both bronchial and anterior and posterior mediastinal glands contain cheesy masses and are three or four times their natural size. About twenty-five tuberculous foci scattered throughout the liver. Two nodules the size of peas in spleen. Udder is tuberculous, containing localized indurations with tubercles and ulcerations on the mucous membrane of the lacteal canals, especially in the left posterior quarter, but supramammary glands are apparently normal.

Carcass condemned.

No. 383. Holstein grade; in fair condition, but has developed characteristic symptoms of traumatic pericarditis. It was considered advisable to slaughter this animal at once, although she had not been subjected to the tuberculin test on account of pyrexia.

Postmortem.—Both lungs show caseous nodules scattered through the pyrenchyma. Bronchial and mediastinal glands greatly enlarged and degenerated. Submaxillary and retropharyngeal glands calcareous. A large fibrous tumor attaching the diaphragm to the reticulum and pericardium is seen embedding a piece of wire three inches in length. The tumor contains pus of a putrid odor.

Carcass condemned.

No. 352. Brown-and-white common stock; eight years old; not in milk; not pregnant; appetite capricious; no use to dairy; submaxillary glands about the size of walnuts; weight, 775 pounds.

Postmortem.—Submaxillary and retropharyngeal glands are all greatly enlarged and contain calcareous foci of tuberculosis. Liver shows three or four greenish abscesses about two inches in diameter, but not of a tuberculous nature.

Carcass passed.

No. 942. Red speckled, common stock; 7 years old; affected with chronic nymphomania; bought fresh three years ago, but has not been pregnant since; no further use to farm superintendent.

Postmortem.—One small well-defined tuberculous nodule in ventral lobe of left lung. Right and left bronchial lymph glands are as large as hens' eggs and have undergone caseous degeneration. Cephalic lymph glands normal.

Carcass passed.

DISINFECTION AND ISOLATION.

The general appearance of the herd, after the removal of the above-mentioned 12 individuals, a number of which showed more or less decided symptoms on physical examination, was quite satisfactory. It would, in fact, have been impossible to find any fault with the condition and appearance of the remaining cows. As before mentioned, there were two large well-ventilated stables 200 or 250 yards from each other, and it was, therefore, an easy matter to provide new quarters for the nonreacting animals. For this purpose the smaller barn was selected; and, in order to avoid a repetition of the extensive spread of the disease, great care was exercised in subjecting the premises to a thorough disinfection and renovation. The boards on the floors were scraped with hoes and were replaced where necessary; the floor, walls, ceiling, stalls, mangers, in fact, the entire stable, was cleaned first with hot water, then with a strong creolin solution. The woodwork was painted, and antiseptic whitewash applied to the brick and stone wall which formed one side of the stable. The old mangers were replaced by modern individual troughs, and the stanchions were constructed in such a manner as to make it impossible for the animals to get their heads together. When this work had been accomplished the 26 nonreacting cattle were stabled there, leaving 66 cows in the infected barn.

From this time the tubercular herd was kept strictly isolated from the healthy cattle and was supplied with separate attendants, dairy utensils, and such other details as were requisite for carrying out this purpose of segregation. The milk of the infected herd was submitted to the boiling temperature for 30 minutes before using, and every precaution was taken in the care of the animals to prevent their rapid decline.

PREVIOUS EXPERIMENTS WITH TUBERCULOUS MILK.

As the question of the infectiousness of milk from tubercular cows was then, as it is now, one of great importance, and as the opinions of the scientists who are recognized as authorities on such matters differ greatly regarding this subject, it was decided to take advantage of the opportunity which had presented itself and ascertain, so far as possible, to what extent the milk of the remaining tubercular, or reacting, cows contained tubercle bacilli. That milk coming from a tuberculous udder is capable of transmitting infection to experimental animals is conceded by all who have given the subject any consideration. It has been equally well established that in advanced generalized tubercu-

losis the udder may excrete tubercle bacilli without showing any indication of being affected. Careful experiments performed by trained and eminently responsible investigators have also demonstrated beyond reasonable doubt that the tubercle bacillus may at certain times enter the general circulation and be eliminated by the normal mammary gland of cows in which the disease is localized or in an incipient stage. Among the earliest investigations which proved positively that milk from tubercular cows contained an infectious principle were those of Gerlach (1869), who produced tuberculosis in calves, hogs, sheep, and rabbits by experiments in feeding, although clinical experience and observation of natural cases had previously led others to form the same opinion.

As early as 1850 the pathological anatomy of the tubercle occurring in the udders of tubercular cows was described by Gluge, and he also spoke of the probability of the milk from such udders transmitting the disease to calves.

Zurn (1872) obtained positive results by feeding swine with the milk of a cow affected with tuberculosis.

Klebs (1873) fed the milk of a tubercular cow to 5 guinea pigs, a dog, and a goat, with the result that 4 of the guinea pigs and both the dog and goat became tubercular. Three guinea pigs injected intra-abdominally with milk filtered through clay all died with lesions of tuberculosis. He concludes that the tuberculous virus is probably present in varying quantities in the milk of cows both greatly and slightly affected.

Semmer (1875–76) inoculated guinea pigs, sheep, and rabbits, some intravenously and others subcutaneously, with the milk of tuberculous cows and produced tuberculosis in 5 out of 11, or 45.4 per cent, of these animals.

Bollinger (1880) infected 1 out of 3 hogs which he fed on the milk of a tuberculous cow. The milk of another cow was fed to 5 hogs, with the result that they all died of tuberculosis. Neither of these cows showed tuberculosis of the udder. Another experiment, in which 6 pigs were used—2 fed cooked milk, 2 uncooked milk, and 2 control pigs—resulted in the death of the 2 animals fed on uncooked milk from a tuberculous cow, while the postmortem examination of the 2 checks and the 2 hogs fed cooked milk showed a normal condition, except an abscess in the liver of one of the last-mentioned hogs. This scientist was the first (1883) to positively establish the virulence of the secretions from a tuberculous udder. In 1883 May inoculated experimental animals with 1½ to 10 c. c. of whole milk which he obtained from the udders of 6 tuberculous cows after they had been slaughtered. The milk from one udder, or 16.6 per cent, transmitted the disease, and in this case the mammary gland was found to be tuberculous.

Johne (1883) has compiled the results of previous feeding experi-

ments with milk of tubercular cows, and, after carefully eliminating questionable investigations, found that of 91 animals fed with this milk, 30.7 per cent became infected with tuberculosis.

Stein (1884) investigated the infectiousness of milk from 14 cows affected with generalized tuberculosis. Of this number 4, or 28.5 per cent, produced tuberculosis by intraabdominal inoculations of the milk into guinea pigs. The udders macroscopically appeared to be normal, but a microscopic examination of the tissues showed the presence of the tubercle bacillus in one of them.

Zschokke (1884) produced tuberculosis in 2 rabbits with the milk of a tubercular cow whose udder did not show any evidence of tuberculosis. His method of inoculation was a combination of the intraperitoneal injection and inhalation by spraying. Both rabbits having developed lesions of the abdominal cavity without any apparent pulmonary alteration proved the former method to be more efficient.

Imlach (1884) fed the milk of 3 tubercular cows to 3 calves, 4 pigs, 1 goat, 2 monkeys, and guinea pigs, with the result that only the monkeys developed experimental tuberculosis.

H. Martin (1884) made a study of the milk sold in Paris dairies. Of 13 samples examined 4 were without results; of the remaining 9, 3, or 33.33 per cent, were found to contain virulent tubercle bacilli by the inoculation of guinea pigs.

Wesener (1885) published the results of previous feeding experiments, 86 in number, conducted for the purpose of determining the infectivity of milk from tubercular cows. The milk was fed to 2 calves, both of which developed tuberculosis, while 75 per cent of the hogs and 50 per cent of the goats and sheep that were likewise fed also became tubercular; 40 per cent of the guinea pigs gave positive results, but rabbits gave very unsatisfactory, and the cats positively negative, results in these feeding experiments.

Bang (1885) in his experiments with milk from cows with tubercular udders produced the disease in 3 rabbits and 5 pigs by feeding. Four rabbits were inoculated with the skim milk from these cows and they all became infected. Microscopic examination of the sediment showed many tubercle bacilli, while a few were also observed in the milk and cream. Subsequently (1889) he tested the milk of 21 tuberculous cows with normal udders by inoculating 48 rabbits. Two, or 9.5 per cent, of these cows transmitted the disease. Later (1892) he injected 40 guinea pigs with milk from 28 cows affected with generalized tuberculosis and showed that virulent milk was being secreted by 4 of the animals, 3 of which were found to have lesions in the udder on postmortem examination. By intraabdominal inoculations of 28 guinea pigs with the milk of 14 tuberculous cows he found that 3 of the latter were excreting tubercle bacilli in the milk. The summary of these experiments shows that of 63 cows 9 gave virulent milk, and

of this number 3 had tuberculous udders, leaving 9.5 per cent of the cows with normal udders producing infectious milk. He concludes that in a majority of cases milk from tubercular cows with healthy udders is not necessarily dangerous, but should be regarded with suspicion.

Galtier (1889) failed to produce tuberculosis in 4 rabbits inoculated with milk from a tubercular cow with a normal udder. In a later experiment he obtained positive results from inoculating a rabbit with milk from an udder but slightly tuberculous. From this he claims that tuberculosis is found only when the udder is affected, but nevertheless believes that milk from all tubercular cows should be suspected.

Peuch (1889) injected 4 rabbits intraabdominally and fed 1 young pig with the milk of a cow having a tuberculous udder. All the rabbits developed generalized tuberculosis, but the pig resisted the exposure. In a previous experiment 2 pigs and 2 rabbits were fed the milk of a tubercular cow, and all became affected.

In the investigations of Hirschberger (1889) this author proved by intraabdominal inoculations of guinea pigs that the milk from 11 out of 20 cows, or 55 per cent, contained the tubercle bacillus. He placed his cows in three groups: the first were generalized cases, of which 80 per cent killed the guinea pigs with tuberculosis; the second were not so badly infected, but 66 per cent producing tuberculosis in the inoculated animals; while the third group contained cows that had lesions localized in the lungs, only 33 per cent of which group gave positive results. In a microscopic examination of the milk from the 11 cows that transmitted the disease, tubercle bacilli could be found in only one case.

Gebhardt (1890) has demonstrated the effect of dilution on the virulence of tuberculous milk. In the first series of experiments 5 guinea pigs were inoculated with milk from a tuberculous cow, as follows:

First with 2.5 c. c. undiluted.	
Second with 2.5 c. c. of a dilution of	1 to 20
Third with 2.5 c. c. of a dilution of	1 to 40
Fourth with 2.5 c. c. of a dilution of	1 to 50
Fifth with 2.5 c. c. of a dilution of	1 to 100

The 2 guinea pigs receiving the undiluted and the 1-to-20 dilution of milk became tubercular. This experiment was twice repeated with practically the same results, from which fact he concludes that a certain degree of dilution (1 to 50) produces a marked diminution in the virulence of tuberculous milk. He also inoculated 10 guinea pigs intraabdominally, each receiving 2 c. c. of milk bought in Munich, with negative results.

J. McFadyean and Woodhead (1892) proved by the inoculation of milk from nontubercular udders, and of an emulsion prepared from the tissue of similar udders, that 2 cases (1 milk and 1 udder) out of 13 in all, or 13.3 per cent, contained the tubercle bacillus.

Fiorentini (1892) conducted 48 milk experiments by inoculating 76 guinea pigs and 4 rabbits. Of these 1 rabbit and 4 guinea pigs became tubercular. It was found on postmortem that 2 of the 17 cows producing the milk were affected with udder tuberculosis.

The previous experiments performed in this laboratory by Smith and Schroeder in 1893, and later by Schroeder (1894), also show the infectious nature of milk from tubercular cows. The first experiment resulted in producing tuberculosis in 41 per cent of the guinea pigs inoculated intraabdominally with the milk from 6 cows affected with generalized tuberculosis. The diseased guinea pigs were inoculated with the milk from 2 of the 6 cows; in other words, 33.33 per cent of the cows were secreting tuberculous milk. The later experiment by Schroeder was divided into three parts. The first, in which market milk from unknown cows was injected into guinea pigs, showed that 1 of 19 samples, or 5.2 per cent, produced tuberculosis in one of the experimental animals inoculated with it. The second was conducted with milk from 12 tubercular cows that had either given a reaction to tuberculin or evinced physical symptoms of the disease. By intraabdominal injections of the sediment of the milk into guinea pigs 1 cow, or 8.3 per cent, was found to be secreting tuberculous milk. The third series consisted in repeated injections intraabdominally of milk from 4 tubercular cows without obtaining any positive results.

In a bacteriological study of St. Petersburg milk, Sacharbekow (1893) inoculated 80 guinea pigs intraabdominally with 4 c. c. each. Four of the animals, or 5 per cent, died as a result of the tubercle bacilli in the milk.

Ernst (1890–1895), in conjunction with Peters, conducted an extensive experiment with the milk of 36 cows that apparently were without any affection of the udder. A microscopic examination of 121 slides made from the milk of these cattle showed 19 slides, or 15.7 per cent, to contain the tubercle bacillus. These 19 slides represented the milk from 12 of the cows, or 33.3 per cent, that were secreting tuberculous milk. Rabbits were injected subcutaneously with the milk and cream from 19 of these cows, 4 of which, or 21 per cent, transmitted the disease. The milk of 15 cows was subcutaneously inoculated into guinea pigs, with the result that 6 cows, or 40 per cent, were found to be excreting tubercle bacilli. By combining the entire number of cattle in this herd that was shown to possess tuberculous milk, it was demonstrated that at one time or another the milk of 50 per cent of the cows proved infectious. This author also fed 21 calves on the milk of 25 tubercular cows and produced tuberculosis in 8, or 38 per cent, of them. The same milk when furnished to 12 pigs caused tuberculosis in 5, or 41.6 per cent, of the animals. The feeding experiments with rabbits resulted in the death of 2 animals, or 4 per cent, from tuberculosis. Twenty-three of the cows whose milk was fed in

this investigation were slaughtered and all but 1 showed perfectly healthy udders on microscopic examination. In a subsequent experiment Ernst inoculated 25 rabbits with the market milk of Boston and 3, or 12 per cent, developed tuberculosis.

De Man (1893), in a series of experimental investigations for the purpose of demonstrating the influence of temperature on the tubercle bacillus, found that 8 guinea pigs inoculated with the emulsion of 4 tuberculous udders contracted tuberculosis.

In the suburbs of Copenhagen St. Friis (1893) obtained milk from 44 dairies each composed of 10 to 80 cows, and made 46 experiments with 84 rabbits and 4 guinea pigs. Of this number 37 rabbits and 4 guinea pigs died a few days after as a result of septic peritonitis, which left only 26 experiments to show final results. Four of these experiments killed 6 rabbits, and it was found later that the 2 dairies furnishing the samples of milk which caused the death of 2 of these rabbits had, respectively, 20 and 30 cows in the herds, 3 of which were affected with udder tuberculosis. The dairies supplying the milk that killed the other 4 rabbits were composed of cows with no apparent lesions of the udders. He also fed 2 rabbits for four months with dairy milk with negative results. The next year this author (1894) reports that of 33 samples of milk obtained from various dairies in Zealand none produced tuberculosis by inoculating laboratory animals.

Pearson (1893) produced tuberculosis in 2 pigs by feeding the milk of a cow which on postmortem showed pulmonary tuberculosis, but no udder lesion. Control pigs gave negative necropsies.

Law (1894) succeeded in infecting 3 calves from healthy parents with the milk of 3 cows affected with generalized tuberculosis but with apparently sound udders.

Hills and Rich (1894) found tuberculosis in a number of hogs that had been fed milk from a herd, 85.7 per cent of which were proved tubercular on postmortem examination, but without udder lesions.

Russell (1894) experimented with the milk of 7 tuberculous cows by inoculating rabbits. One cow, or 14.2 per cent, gave milk which killed both of the inoculated animals. The microscopic examination of the udder of this cow revealed the presence of the bacillus of tuberculosis.

Nocard (1896) obtained positive results in 3 out of 54 cases, or 5.5 per cent, by using milk from cows with advanced generalized tuberculosis. On further examination the udders of all 3 revealed tubercular lesions. He also claims (1884–1885) that the milk of tubercular cows will not transmit tuberculosis unless the udder is tuberculous. He examined the milk from a cow affected with advanced generalized tuberculosis, but found no tubercle bacilli present.

Obermüller (1897) injected small quantities of centrifugalized sediment of mixed milk into experiment animals and produced tuberculosis in 38 per cent of the animals. Later, 14 samples of butter made from the milk of these cows were injected into guinea pigs, resulting in the development of tuberculosis in every case.

The virulence of the market milk of Genoa, Italy, was studied by Massone (1897) by intraabdominal injection of guinea pigs, and it was found that the milk in 9 per cent of the samples contained virulent bacilli. The report of the medical officer of health of Liverpool to the Health Commission for 1897 records the examination, by the microscope and by inoculation experiments, of 158 samples of milk from different sources. Of 122 samples of city milk, 3, or 2.4 per cent, were found tuberculous. Of 24 specimens of country milk procured at the railway stations, 7, or 29.1 per cent, contained the bacillus of tuberculosis.

Delepine (1897) injected 36 samples of milk from Liverpool into guinea pigs, and found 1 sample, or 2.8 per cent, to contain the tubercle bacillus. In another series of experiments 2 out of 9 samples of milk from Liverpool were shown to be infectious to guinea pigs. This author also inoculated milk direct from the udders of 24 tuberculous cows, and found that 6, or 25 per cent, of the number produced tuberculosis in the guinea pigs. In a later article Delepine (1901) gives a table of the results obtained by inoculating guinea pigs with the milk of tubercular cows since 1896, and shows that 22.2 per cent of the cattle transmitted the disease.

Further evidence has been furnished by Ravenel (1897), who investigated the infectiousness of mixed milk from 5 tubercular cows with healthy udders by intraabdominal inoculation of guinea pigs. In 3 series of experiments, in which the milk was injected in its natural condition, 10 out of 66 guinea pigs, or 15.8 per cent, contracted tuberculosis as a result of the injection.

Petri (1898) injected 478 guinea pigs with 64 samples of the market milk of Berlin. In this investigation positive results were obtained in 9, or 14 per cent, of the cases, while 4, or 6.3 per cent, showed the acid-proof bacillus.

Beuge (1898) inoculated 18 guinea pigs intraabdominally with milk obtained in Halle. Eight of these animals died within a few days with septic peritonitis, while of the remaining 10 there were 3, or 30 per cent, that developed tuberculosis.

Ott (1898) proved that out of 43 samples of mixed milk 5, or 11.6 per cent, were infected. Ten guinea pigs each received intraabdominally 5 c. c. of mixed cream and sediment from the above 5 sources and 7 became tubercular. Of 30 guinea pigs inoculated with 5 c. c. of the whole milk 2 died of peritonitis, 4 died as a result of tuberculosis,

while the postmortem examination of 4 others that died of intercurrent diseases showed lesions which contained the tubercle bacillus, making 8 out of 28, or 28.5 per cent, tuberculous.

Kudinow (1898), in a study of the microorganisms present in the market milk of Dorpat, found by intraperitoneal inoculations of guinea pigs that 2.5 per cent of the samples contained the tubercle bacillus and concluded that the percentage was even greater, since many of the animals died as a result of other pathogenic bacteria in the milk before the tubercle bacillus had an opportunity to produce extensive lesions.

Kanthack and Sladen (1899) report that out of 16 dairies supplying 10 English colleges with milk 9, or 56.2 per cent, contained virulent tubercle bacilli. In this experiment 90 guinea pigs were used, 23, or 25.5 per cent, of which showed typical histological lesions. Thirteen of these were inoculated with cream, while 10 received injections of the centrifugalized sediment.

A. MacFayden (1899) examined 100 samples of the milk supply of Hackney district. Twenty-three of these samples caused peritonitis in the inoculated animals before tuberculous lesions could be established, while in the remaining 77 samples 17, or 22 per cent, produced tuberculosis.

Ostertag (1899) contends that the infection is to be considered only when the cow is sensibly affected, and in order to obtain evidence of the bacilli in milk of cows that do not show clinical symptoms, this investigation was undertaken. In the first experiment with the individual milk from 49 cows but 1 guinea pig died of tuberculosis, and this animal, the author claims, must have been infected before receiving the inoculation of milk. In another experiment with the mixed milk from this herd, 14 samples were used with the result that 1 of these samples, or 7.1 per cent, transmitted tuberculosis to 1 of 3 guinea pigs intraabdominally inoculated with the cream sediment. From this the author states: "The result of our second experiment plainly shows that in latent tuberculosis tubercle bacilli will occasionally find their way into the blood channels and from this source they may be carried through the milk into the outer world." At the same time he concludes that the milk of such cows offers no serious menace to the public health.

In direct opposition to this conclusion are those of Rabinowitsch and Kempner (1899), who succeeded in producing tuberculosis in guinea pigs with the milk of 10 out of 15 tuberculous cows, or 66.6 per cent. Two of these cows were later found to have tuberculous udders, 3 showed advanced generalized tuberculosis, while the remaining 5 animals were but slightly affected. The writers conclude that milk from cows with incipient tuberculosis, but without disease of the udder, may contain tubercle bacilli; also in latent forms of tuberculosis the milk may prove infectious, although the cow may not present any

clinical symptoms of tuberculosis, and therefore milk from all cows reacting to tuberculin should be considered as at least suspicious.

In 1897 Rabinowitsch showed by intraperitoneal injections of guinea pigs that 7, or 28 per cent, of the 25 samples of Berlin milk tested contained nocuous tubercle bacilli. This writer (1900) also studied the unsterilized milk of Berlin firms who sell their product at increased prices especially for the use of infants and invalids. Three of these dairies contained tuberculin-tested cows, while the remaining 5 were not subjected to such strict veterinary supervision. By intraperitoneal inoculation of guinea pigs it was observed that the milk of 3 of these 5 dairies possessed living virulent tubercle bacilli.

Adami (1899) believes that the cells of an actively secreting mammary gland of a cow can take up and discharge the tubercle bacillus without the animal showing any lesion of the lacteal tract. He and Martin examined the milk of 10 cows and when these were killed the udders were subjected to microscopic examination with negative results. In the milk of 6 (60 per cent) of these cows tubercle bacilli were observed by the aid of the microscope. The milk from the cow showing the greatest number of bacilli was inoculated into 2 guinea pigs and both died as a result of the infection. Twenty-nine guinea pigs and 26 rabbits were inoculated with varying quantities of milk and 1 calf was fed for five months, but only 2 guinea pigs died of tuberculosis.

Roger and Garnier (1899) injected the milk of a tubercular cow without udder lesions into the peritoneal cavity of 2 guinea pigs. They both contracted tuberculosis. The calf of this cow was allowed to suckle for only two days, but six weeks later it died with tuberculous lesions of the mesenteric lymph glands, the liver, spleen, and kidney.

In an article on tuberculosis, Annett (1900) publishes the results obtained by Boyce, who in 1898 examined 84 samples of Liverpool milk, of which 7, or 8.5 per cent, produced tuberculosis when inoculated into guinea pigs. In the study of 28 samples of country milk, 5, or 17.8 per cent, proved virulent to guinea pigs. In 1899, Boyce repeated these experiments, using 75 samples of town milk and 63 specimens of country milk, with the result that 6.6 per cent and 17.4 per cent, respectively, of these milks produced tuberculosis.

Marcone (1900) demonstrated the virulence of Naples milk by intraperitoneal inoculation of guinea pigs. Two series of experiments were conducted with the milk of 100 cows. In order to avoid a long series of experiments with each cow's milk separately, he collected the milk of several cows to form a single sample for study, so that the milk of the hundred cows was divided into 14 samples. In the first test of these samples 2 failed to give results, 6 gave positive, and 6 negative, or 50 per cent produced tuberculosis. In the second series of re-

searches the results were similar, since 7 gave positive and 7 negative findings.

Gehrman and Evans (1900) found tubercle bacilli in the milk of 15 out of 41 cows with sound udders, or 36.6 per cent. Guinea pigs inoculated with milk from 10 of these cows died of tuberculosis (24.3 per cent). As these results were not obtained from the same cows, the final showing is that 16 of the cows at one time or another gave milk containing tubercle bacilli, or 39.02 per cent. In 1895 Gehrman demonstrated by the microscopic examination of the milk of 38 cows with normal udders that 4, or 10.5 per cent, contained the tubercle bacillus. Subcutaneous inoculation of guinea pigs established the virulence of the tubercle bacillus in the secretions of 6, or 15.7 per cent, of the cows.

The most casual examination of the evidence deduced from these numerous experiments, performed by the leading investigators of many countries, shows clearly the danger to a susceptible subject of milk from a cow affected with tubercular mammitis or with advanced generalized tuberculosis which may be recognized by physical examination. The observations and deductions regarding this group of cases are practically uniform and the contradictory opinions appear to be relative to the possibility of a tuberculous cow with a healthy udder and without clinical appearances of the disease producing infectious milk. In the latter instance the evidence seems to be that the milk of such tubercular animals is capable of transmitting tuberculosis, the controversy relating more to the percentage of positive results obtained than to the diverse opinions of these investigators. While the tuberculin test can not be considered as an exclusive method for determining the infective property of milk, still the milk from cows which have given no other evidence of the presence of tuberculosis has, in a number of instances above related, produced the disease in susceptible animals. It has also been demonstrated and accepted by the majority of these writers that the infectivity of the milk of tuberculous cows increases with the stage and extent of the disease, as would be expected, but, on the other hand, the experiments of Gebhardt have shown that the danger of infection is diminished by mixing the milk of a number of cows together so that any infected sample becomes diluted.

In view of the evidence above submitted, it is apparent that the conclusion which maintains a sharp line of demarcation between the time immediately before the tubercle bacilli find lodgment on the susceptible mucous membrane of the lacteal tract and the period directly after such involvement occurs with the consequent pathological changes can not be considered as logical. Moreover, histological, bacteriological, and inoculation tests have disproved such reasoning and have fully demonstrated that the bacillus of tuberculosis may be eliminated by the blood through the mammary gland without this organ becoming affected. Despite these valuable contributions to our knowledge

of the infectiousness of milk from tuberculous cows, and although the study has been prosecuted for many years, there are many problems yet unsolved, and this most important subject still warrants additional experimentation and investigation to ascertain accurately and establish firmly the disputed points.

PRESENT INVESTIGATION.

For the reasons already mentioned and in consequence of the direct relation which tuberculous milk bears to human health, as well as to determine more definitely the relation which exists between the clinical aspect of the cows which have reacted to the tuberculin test, but which on physical examination are apparently healthy, and the infectivity of their milk, it was decided to ascertain, through feeding and inoculation experiments, whether the milk from the cows in question contained virulent tubercle bacilli, and, if so, to what extent. Samples of milk were therefore obtained in a sterile bottle from each cow once a day and carried immediately to this laboratory. Fifty-two of the 66 reacting cows were in milk, while the remaining 14 were dry, but subsequently 4 of these animals came in milk and were included in the experiment.

TECHNIQUE OF MILK INOCULATIONS.

METHOD OF WORK.

All milk used in these experiments was obtained about 2 o'clock daily, and consisted of the first portion of the milking, excluding the first few streams, which were always discarded in collecting the samples. Half-pint bottles were used in carrying the milk for the feeding experiments, and they were supplied with tight-fitting metallic covers. These bottles were always sterilized in the laboratory on the morning of the day on which they were to be used. The teats and udders were dampened with a 2 per cent solution of creolin, and, if possible, even more careful precautions were observed in securing the milk from the cows for intraabdominal inoculation. The milk for this purpose was collected in 1-liter serum bottles from but 2 cows a day. The bottles were then placed in the ice chest over night in order to allow the formation of cream. The following morning the cream was removed with a sterilized pipette, shaken up with twice its volume of sterilized water, and centrifugalized by electricity for 15 minutes at the rate of about 2,500 revolutions per minute. This apparatus was devised by replacing the hub and blades of an electric desk fan by the shoulder and arms of the medical hand centrifuge. This centrifugal machine was attached to the wall in an inverted position and encircled with a sheet of galvanized iron to prevent injury to the manipulator. With this electric apparatus work was made less laborious and also gave a more constant and uniform precipitation of the milk than could have been accomplished otherwise. The sediment

obtained was then injected into guinea pigs after the supernatant fluid had been drawn off with a sterile pipette.

After the cream had been removed from the original bottle for centrifugalizing, the milk was siphoned off to within 6 to 8 cm. of the bottom of the jar. This portion containing the sediment was drawn up with a sterile pipette and emptied into the tubes of the centrifugal machine. It was then subjected to the same treatment as the cream. In all cases from 4 to 6 cover-glass preparations were made from the centrifugalized sediment of both the milk and the cream, and examined microscopically after staining by Ziehl-Nielsen's method. All the injections were made into the peritoneal cavity of the guinea pigs after adhering to the usual aseptic precautions. The hair was clipped from a small area in the abdominal region, after which the skin was thoroughly carbolized, washed with alcohol, and rinsed with sterilized water.

The quantity injected varied somewhat, the first twelve receiving from 1 to 2 c. c., after which the amount was increased from 2 to 3 c. c., and still later as high as 5 c. c. was introduced into the abdomen. The milk was gathered by one of the laboratory assistants thoroughly acquainted with the precautions that should be observed in procuring it. As a rule, within one hour after it had been collected the milk would reach the laboratory and the contents of the small bottles fed at once to the guinea pigs, while the large bottles containing the milk for injection were kept on ice until the following morning. Three guinea pigs were assigned to each cow for the feeding experiments. In the inoculation tests 3 guinea pigs were usually injected in the first and 4 in the second series. The animals used in this investigation were in good condition and weighed from 11 to 19 ounces. They were obtained some from our own breeding pens and others from a well-known breeder with whose premises we are perfectly familiar. Spontaneous tuberculosis has not been known to occur in either place. Owing to an unfortunate circumstance it was possible to hold a post-mortem on 16 animals from the last-mentioned pens before the milk experiment had started, and this examination did not reveal any evidences of tuberculosis.[a] All the animals in these experiments were placed in new cages and every known precaution was observed to prevent contamination from external sources. When deaths occurred the organs were carefully examined, cover-glass preparations made of the lesions, and the affected tissues preserved in Kaiserling's fluid. Owing to the more or less uncertain results obtained from making cultures, this procedure was dispensed with after a short trial, but in many cases the microscopic findings of the tubercle bacilli in sections

[a] A number of guinea pigs had been placed in a box awaiting the arrival of some new cages, and inadvertently had been covered with other boxes, which, together with the extreme hot weather then present, caused 16 of them to be asphyxiated.

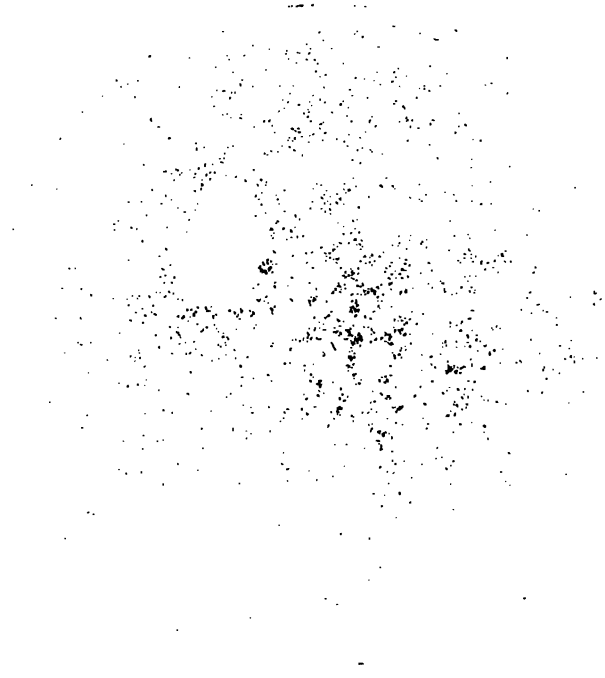

Fig. 1

Fig. 2

ERCLE RABBIT IN NATURAL AND CENTRIFUGALIZED MILK PREPARATION.

Description of Plate I.

Fig. 1. Cover-glass preparation of the uncentrifugalized milk of cow No. 102. Stained by Ziehl-Nielsen's method. Drawing made with Zeiss 2 mm. oil immersion objective and No. 4 compensating ocular.

Fig. 2. Cover-glass preparation of the milk sediment from cow No. 102. Stained by Ziehl-Nielsen's method. Drawing made with Zeiss 2 mm. oil immersion objective and No. 4 compensating ocular.

FIG. 1

FIG. 2

FIG. 1.—TUBERCULOSIS BACILLI FROM SPLEEN OF GUINEA PIG. No. 28 A, COW No. 69

FIG. 2.—TUBERCULOSIS BACILLI FROM LIVER OF GUINEA PIG. No. 1563, COW No. 85.

Description of Plate II.

Fig. 1. Cover-glass preparation from a caseous focus in the spleen of guinea pig No. 28a, fed with milk from cow No. 65. Stained by Ziehl-Nielsen's method. Drawing made with Zeiss 2 mm. oil immersion objective and No. 4 compensating ocular.

Fig. 2. Cover-glass preparation from a caseous focus in the liver of guinea pig No. 1563, inoculated intra-abdominally with the milk sediment from cow No. 85. Stained by Ziehl-Nielsen's method. Drawing made with Zeiss 2 mm. oil immersion objective and No. 4 compensating ocular.

and cover-glass preparations were substantiated by a subseries of inoculations of an emulsion of the lesions into guinea pigs. (See table below.) This latter work was carried out for the purpose of establishing beyond peradventure that the lesions produced by the milk in these experiments were the result of the tubercle bacillus and not dependent upon the action of any of the "acid proof" bacteria. Only in the case of 3 guinea pigs inoculated with the milk of cow No. 85 (see p. 58) were the lesions caused by one of these microorganisms, Moeller's grass bacillus. (See Plate II, fig. 2.) This mycobacterium might be taken for the tubercle bacillus when the filaments become disrupted. It is also capable of producing lesions of a pseudotuberculosis in guinea pigs that would lead to confusion unless closely studied microscopically. In addition to this microorganism several others were isolated from the lesions resulting from these experiments, and in certain cases (cows Nos. 68, 79, and 105) they were directly responsible for the early fatalities noted. Among those most constantly present were staphlococci, streptococci, diplococci, sarcina, bacillus coli communis, bacillus mesentericus, pseudomonas pyocanea, bacillus subtilis, bacillus aromaticus, and several undetermined species.

Forty-three guinea pigs for use as checks in this investigation were placed in cages between the experimental animals and subjected to the same external influences as the latter. (See p. 26.) The results were entirely negative, but they support incidentally the positive evidence of the infectivity of the milk given below.

Positive results obtained by subinoculations of guinea pigs.

Guinea pig No.	Date of injection.	Source of material injected.	From cow No.	Date of death.	Postmortem diagnosis.
1075	Sept. 8	Guinea pig 12a	4	Oct. 19	Tuberculosis.
1125	Sept. 10	Guinea pig 10a	4	Sept. 23	Do.
1126	....do	Guinea pig 19a	15	Oct. 2	Do.
141	Sept. 29	Guinea pig 31	64	Oct. 17	Do.
78	Aug. 22	Guinea pig 29a	65	Sept. 29	Do.
79	....do	.....do	65	Oct. 7	Do.
143	Sept. 30	Guinea pig 43a	71	Oct. 27	Do.
91	Sept. 16	Guinea pig 46a	73	Oct. 9	Do.
1782	Sept. 20	Guinea pig 50a	74	Nov. 8	Do.
1783	....do	.....do	74	Nov. 27	Do.
1079	Sept. 9	Guinea pig 58a	77	Sept. 30	Do.
1723	Nov. 25	Guinea pig 1682	98	Dec. 12	Do.
84	Aug. 31	Guinea pig 99a	102	Sept. 29	Do.
1944	Dec. 15	Guinea pig 1649	102	Jan. 14	Do.
1945	Dec. 18	Guinea pig 1650	102	Jan. 2	Do.
1355	Sept. 12	Guinea pig 103a	104	Oct. 11	Do.

Check guinea pigs.

Guinea pig No.	Location.	Date when killed or died.	Postmortem.
976	Adjoining cage 10[a]	Oct. 23, 1900	No lesion.
993	Adjoining cage 16	Dec. 17, 1900	Do.
1022	....do	....do	Do.
1156	Adjoining cage 72	Dec. 10, 1900	Do.
1183	Adjoining cage 77	Dec. 30, 1900	Do.
1184	Adjoining cage 74	Nov. 7, 1900	Do.
1185	....do	Oct. 31, 1900	Do.
1186	Adjoining cage 66	Dec. 17, 1900	Do.
1187	....do	Sept. 12, 1900	Septic metritis.
1188	Adjoining cage 3	Jan. 22, 1901	No lesion.
1189	Adjoining cage 79	Dec. 10, 1900	Do.
1192	Adjoining cage 68	Sept. 17, 1900	Pneumonia.
1193	....do	Jan. 8, 1901	No lesion.
1194	....do	....do	Do.
1200	Adjoining cage 19	Dec. 6, 1900	Do.
1201	....do	Dec. 28, 1900	Do.
1202	....do	....do	Do.
1203	Kept in one large cage facing the experiment animals.	Dec. 10, 1900	Do.
1204		Nov. 2, 1900	Pneumonia.
1205		Dec. 30, 1900	No lesion.
1206		Dec. 16, 1900	Do.
1210		....do	Do.
1211		....do	Do.
1212		Aug. 2, 1900	Pneumonia.
1254	Adjoining cage 5	Nov. 9, 1900	No lesion.
1260	....do	....do	Do.
1275	Adjoining cage 86	Dec. 30, 1900	Do.
1276	....do	....do	Do.
1280	Adjoining cage 76	Oct. 31, 1900	Enteritis.
1281	....do	Dec. 10, 1900	No lesion.
1305	Adjoining cage 106	Nov. 14, 1900	Do.
1309	....do	....do	Do.
1310	Adjoining cage 1	Nov. 12, 1900	Do.
1311	....do	....do	Do.
1312	Adjoining cage 95	Dec. 10, 1900	Do.
1313	Adjoining cage 78	Oct. 17, 1900	Do.
1314	....do	....do	Do.
1315	Adjoining cage 100	Jan. 22, 1901	Do.
1316	Adjoining cage 91	....do	Do.
1317	....do	Nov. 2, 1900	Do.
1318	Adjoining cage 108	Nov. 16, 1900	Do.
1319	....do	....do	Do.
1389	Adjoining cage 112	Jan. 22, 1901	Do.

[a] Number of cage corresponds to the number of the cow.

CONDENSED STATISTICS RELATING TO THE MILK EXPERIMENT.

The following tables show, in a form convenient for comparison, the history, physical examination, tuberculin reaction, and postmortem examination, together with the results of the feeding and inoculation experiments, as well as the microscopic examination of the milk and cream of each individual cow in this test.

Cow No. 1. St. Elizabeth herd.

Age, 6 years; condition, fleshy; number of calves, 4; breed, grade Ayrshire; origin, raised.

Physical examination, September 26, 1900: Pulse, 38; respiration, 22; temperature, 101.4°. Superficial lymph glands, normal. Lungs: Percussion, normal; auscultation, normal.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	101.8°	102.8°
9 a. m	100.9	102.8
12 m	101	104.8
3 p. m	101	103.6
6 p. m	101.8	103.2

Postmortem, Rosslyn, Va., December 17, 1900: Caudal node of posterior mediastinal lymph gland enlarged to size of a hen's egg, and contains caseous material. The other glands in this chain are slightly enlarged and contain a few necrotic centers from one-fourth to five-eighths of an inch in diameter. Eight or nine of the mesenteric lymph glands show a few tubercles from the size of a hemp seed to that of a pea.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
1a	July 19 to Sept. 27 ..	80	Sept. 27	70	Not tuberculosis	
2a	July 19 to Oct. 9	80	Oct. 17	90	.....do.....	
3a	July 19 to Aug. 22 ..	80	Aug. 22	34	.....do.....	

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
1	July 26	Milk and cream	1.5	Oct. 31	97	No lesions.....	
2	....do...	.....do.....	1.5	Oct. 15	81	.....do.....	
3	....do...	.....do.....	1	Oct. 28	94	.....do.....	

SECOND SERIES.

Cow dry.

Cow No. 2. St. Elizabeth herd.

Age, 7 years; condition, good; number of calves, 4; breed, Holstein grade; origin, raised.

Physical examination October 18, 1900: Pulse, 42; respiration, 16; temperature, 100.6°. Superficial lymph glands, normal. Lungs, normal.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	101.9°	105.6°
9 a. m	101.8	104.8
12 m	101.6	105.6
3 p. m	101.8	104.1
6 p. m	102	102.8

Postmortem, Rosslyn, Va., December 11, 1900: One firm, caseous area about 2 inches in diameter in ventral lobe of right lung and surrounded by an inflammatory zone. Several encysted tuberculous foci in parenchyma of left caudal lobe about the size of a shellbark, which appear slightly calcareous on section.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
4a	July 9 to Oct. 9	80	Nov. 23	137	No lesions	
5a	do	80	Oct. 10	93	Not tuberculosis	
6a	do	80	Nov. 5	119	No lesions	

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
4	July 26	Milk and cream.	2	Oct. 11	77	No lesions	
5	do	do	1.5	Nov. 13	110	do	
6	do	do	1	Sept. 11	47	Pneumonia	

SECOND SERIES.

1397	Oct. 11	Milk	8	Nov. 3	23	Not tuberculosis	
1398	do	do	5	Dec. 3	53	No lesions	
1399	do	Cream	3	Dec. 13	63	do	

Cow No. 3. St. Elizabeth herd.

Age, 6 years; condition, fair; number of calves, 4; breed, Ayrshire grade; origin, raised.

Physical examination, October 18, 1900: Pulse, 39; respiration, 21; temperature, 102.1°. Superficial lymph glands, normal. Lungs, normal.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	101.8°	102°
9 a. m	101.6	102.5
12 m	102	105.1
3 p. m	102.6	105
6 p. m	102.5	104.4

Postmortem, Fowlers, D. C., May 31, 1901: Two small, caseous nodules one-half inch in diameter, in cephalic lobe of right lung and three smaller areas in ventral lobe of left lung. In the large posterior mediastinal gland there is one tuberculous focus about one-half inch in diameter, completely calcified. One mesenteric gland is involved and contains a partly calcareous nodule three-eighths inch in diameter.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
7a	July 9 to Oct. 9	80	Dec. 10	154	No lesions	
8a	do	80	Dec. 11	155	do	
9a	do	80	Dec. 30	174	do	

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
7	July 27	Milk and cream.	2	Nov. 6	102	No lesions	
8	....do	.....do	2	Oct. 22	87	.....do	
9	....do	.....do	1	Oct. 15	80	.....do	

SECOND SERIES.

1401	Oct. 12	Cream	3	Jan. 25	105	No lesions	
1402	....do	.....do	5	Jan. 29	109	.....do	
1403	....do	Milk	5	Dec. 20	69	Pneumonia	Negative.
1404	....do	.....do	3	Nov. 10	29	Not tuberculosis	

Cow No. 4. St. Elizabeth herd.

Age, 6 years; condition, fair; number of calves, 3; breed, Ayrshire grade; origin, raised.

Physical examination October 18, 1900: Pulse, 36; respiration, 19; temperature, 100.6°. Superficial lymph glands, normal. Lungs, normal.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 p. m	101.8°	102.3°
9 p. m	100.2	104.6
12 m	100.8	106.2
3 p. m	101.6	106.4
6 p. m	101.4	104.6

Postmortem, March 26, 1901, at Fowlers, D. C.: Right posterior pharyngeal lymph gland contains several small tuberculous foci. Left posterior pharyngeal gland is completely degenerated, about the size of a pigeon's egg, and contains cheesy pus. The prepectoral glands are enlarged and show foci of tuberculosis. Left bronchial lymph gland is tuberculous and the posterior mediastinal glands contain five or six small caseous centers. The right principal lobe of lung contains five or six caseous areas varying in size from a pea to a hen's egg. One small focus in caudal lobe of left lung. The parietal pleura is covered with a tuberculous growth (pearl disease), forming adhesions with the right lung and extending over the thoracic surface of the diaphragm.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
10a	July 9 to Sept. 10	80	Sept. 10	63	Tuberculosis	Positive.
11a	July 9 to Sept. 26	80	Sept. 26	79	.....do	Do.
12a	July 9 to Sept. 8	80	Sept. 8	61	.....do	Do.

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
10	July 27	Milk and cream.	2	Sept. 8	43	Tuberculosis	Positive.
11	....do	.....do	1.5	Nov. 6	102	No lesions	
12	....do	.....do	1	Nov. 7	103	.....do	

SECOND SERIES.

1403	Oct. 11	Milk	5	Dec. 7	57	Not tuberculosis	
1404	....do	.....do	3	Dec. 29	79	No lesions	
1405	....do	Cream	5	Dec. 19	69	.....do	
1406	....do	.....do	3	Nov. 1	20	Pneumonia	

Cow No. 5. St. Elizabeth herd.

Age, 7 years; condition, good; number of calves, 3 or 4; breed, Holstein; origin, raised.

Physical examination, October 18, 1900: Pulse, 47; respiration, 24; temperature, 101.1°. Superficial lymph glands, normal. Lungs, normal.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	101.4°	101.7°
9 a. m	101.3	102.4
12 m	101.4	106.5
3 p. m	101.1	105.4
6 p. m	102.1	106

Postmortem, Rosslyn, Va., February 1, 1901: Small calcareous focus the size of a hazelnut in ventral lobe of right lung. Anterior mediastinal gland contains three or four encapsulated foci one-third of an inch in diameter and of a gritty consistency.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.[a]

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions
		c. c.				
13a	July 9 to July 15	80	Oct. 18	101	No lesions	
14a	.....do	80	Oct. 4	87	.....do	
15a	.....do	80	Nov. 7	121	.....do	

[a] This animal became dry shortly after feeding experiments began.

Cow No. 8. St. Elizabeth herd.

Age, 9 years; condition, good; number of calves, (?); breed, common; origin, bought three years ago.

Physical examination, September 19, 1900: Pulse, 50; respiration, 20; temperature, 101.6°. Glands: Submaxillary, normal; supramammary, normal; udder, normal. Lungs, normal.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	101.6°	105°
9 a. m	101.4	105
12 m	101.2	106.2
3 p. m	101.2	106.5
6 p. m	102	103.8

Postmortem, Rosslyn, Va., December 17, 1900: Both retropharyngeal glands show several necrotic areas the size of hemp seeds. Left tonsil contains purulent nodule the size of an acorn. Few small necrotic foci in posterior mediastinal glands. One cluster the size of a hen's egg in anterior portion of principal lobe of right lung, which on section is partly calcareous. Similar lesion in apex of left lung.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
121a	July 9 to Sept. 23	80	Nov. 16	130	Normal	
122a	do	80	Dec. 29	173	do	
123a	do	80	Dec. 5	149	do	

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
13	July 28	Milk and cream.	3	Sept. 8	42	Not tuberculosis	
14	do	do	2	Oct. 6	70	Normal	
15	do	do	2	Oct. 15	79	do	

SECOND SERIES.

Cow dry.

Cow No. 10. St. Elizabeth herd.

Age, 6 years; condition, excellent; number of calves, 3; breed, grade Ayrshire; origin, raised.

Physical examination, October 10, 1900: Pulse, 38; respiration, 22; temperature, 101.7°. Lymph glands: Submaxillary, normal, supramammary, normal. Lungs: No record of examination.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	102°	102.4°
9 a. m	101.5	102
12 m	102.6	104.2
3 p. m	102.6	105.8
6 p. m	102.3	103.8

Postmortem, at experiment station, Bethesda, Md., November 13, 1901:[a] Numerous foci of tuberculosis in the lymph glands at the base of the tongue. The glands are enlarged and the foci vary in size from one-eighth to 1 inch. The centers of some are softened, and a deposit of calcareous matter is present in the peripheral portions of the foci. The mediastinal glands are somewhat enlarged and contain tubercular foci in a partly broken-down condition. Scattered over the costal and pulmonary pleura are numerous tubercular excrescences which vary in size from a pea to confluent masses 4, 5, and 6 inches in diameter. Sprinkled throughout the lungs are groups of isolated and confluent tubercular nodules varying in size from one-eighth to 3 inches, some of which are in a broken-down condition and in direct communication with the bronchi. Scattered over the pericardium are tubercular growths similar to those on the pleura. On the surface of the liver, each adherent to it by means of a narrow band of tissue, are several tubercular tumors, from one-half to 2 inches in diameter. A few small tubercular foci are seen in the liver and portal glands. Surface of spleen and omentum are covered with tubercular excrescences.

Microscopic examination of centrifugal sediment of milk, positive; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
124a	July 9 to Aug. 21	80	Aug. 21	43	Pyemia	Negative.
125a	July 9 to Oct. 9	80	Dec. 13	157	Pneumonia	Do.
126a	.....do	80	Oct. 10	93	No lesions	
127a	.....do	80	Nov. 5	119	.....do	

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
16	July 28	Milk and cream.	3	Sept. 16	50	Not tuberculosis	
17	.....do	.....do	2	Oct. 28	92	No lesions	
18	.....do	.....do	2	Nov. 5	100	.....do	

SECOND SERIES.

1409	Oct. 11	Cream	5	Jan. 12	93	No lesions	
1410	.....do	.....do	3	Dec. 17	67	.....do	
1411	.....do	Milk	5	Dec. 30	80	.....do	
1412	.....do	.....do	3	Nov. 27	47	Not tuberculosis	

Cow No. 12. St. Elizabeth herd.

Age, 8 years; condition, fair; number of calves, 4; breed, grade Holstein; origin, raised.

Physical examination, January 4, 1901: Pulse, 52; respiration, 24; temperature, 102.9°. Glands: Submaxillary, normal; supramammary, normal. Lungs: Percussion, apparently normal; auscultation, right lung, increased bronchial breathing; left lung, increased bronchial breathing.

[a] For the postmortem notes on cow No. 10 the writer is indebted to Dr. E. C. Schroeder, superintendent of experiment station, Bethesda, Md.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	101.9°	105.5°
9 a. m	102.8	107.4
12 m	102.6	104.9
3 p. m	102.8	104.9
6 p. m	102.8	103.7

Postmortem, Rosslyn, Va., February 5, 1901: Both lungs show miliary tuberculosis throughout the parenchyma of all the lobes. The parietal pleura on both sides contains numerous isolated and confluent grape-like masses (pearl disease). The bronchial and entire chain of mediastinal glands are enlarged and caseous. Five or six of the mesenteric glands enlarged, and contain cheesy deposits.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative

Feeding experiments

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
119a	July 9 to Oct. 9	80	Nov. 28	142	No lesions	
120a	do	80	Nov. 11	125	do	
121a	do	80	Dec. 21	165	No evidence of tuberculosis.	

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
22	July 30	Milk and cream.	1.5	Oct. 24	86	Normal	
23	do	do	3	Oct. 15	77	do	
24	do	do	2	Oct. 7	69	do	

SECOND SERIES.

1420	Oct. 12	Cream	5	Dec. 26	75	No lesions	
1421	do	Milk	3	Dec. 6	55	Tuberculosis	Positive.
1422	do	do	5	Dec. 26	75	No lesions	

Cow No. 14. St. Elizabeth herd.

Age, 5 years; condition, good; number of calves, 2; breed, Ayrshire; origin, raised.

Physical examination, September 19, 1900: Pulse, 46; respiration, 17; temperature, 101°. Superficial lymph glands, normal. Lungs, normal.

Tuberculin test.

Hour.	May 2, 1900. Before injection	May 3, 1900 After injection.
6 a. m	102°	103.1°
9 a. m	100.1	103.8
12 m	100.1	105.1
3 p. m	101.6	105.2
6 p. m	101.7	104.2

Postmortem, Rosslyn, Va., February 5, 1901: Caudal lobe of right lung contains a walnut-sized nodule, which appears calcareous on section. A few isolated excrescences are seen on the parietal pleura of each side. The entire posterior mediastinal chain of glands are enlarged, and the lymph structure is completely replaced by a calcareous deposit. Left bronchial gland is the size of a duck's egg and likewise calcified.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
16a	July 9 to Oct. 9.....	80	Oct. 24	107	No lesions.....	
17a	July 9 to Sept. 9....	80	Sept. 9	62	Not tuberculosis.....	
18a	July 9 to Oct. 9.....	80	Nov. 20	134	No lesions.....	

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
19	July 30	Milk and cream.	3	Nov. 3	96	No lesions.....	
20	....do...	.....do.....	2	Nov. 12	105	.....do.....	

SECOND SERIES.

Cow dry.

Cow No. 15. St. Elizabeth herd.

Age, 7 years; condition, fairly good; number of calves, 4; breed, grade Holstein; origin, raised.

Physical examination, October 10, 1900: Pulse, 42; respiration, 20; temperature, 101.2°. Glands: Submaxillary, normal; supramammary, normal; udder, normal. Lungs, normal.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	101°	106.9°
9 a. m	101	105.2
12 m	101.3	106.1
3 p. m	101.5	106.9
6 p. m	103	106

Postmortem, Rosslyn, Va., December 17, 1900: Caudal lobe of left lung has a number of caseous areas from the size of a pea to that of a walnut. Posterior mediastinal glands are enlarged and contain five centers of tuberculosis of a semicalcareous nature. The bronchial and prepectoral glands are slightly enlarged and contain small yellow tubercles that are undergoing cheesy necrosis. Two tuberculous ulcers, size of quarter and dime, at bifurcation of trachea. Six or seven of the mesenteric glands show a number of small caseous foci. Liver shows a caseous tuberculous focus size of a pea.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
19a	July 9 to Sept. 10....	80	Sept. 10	63	Tuberculosis.....	Positive.
20a	July 9 to Sept. 11....	80	Sept. 11	64	.....do.....	Do.
21a	July 9 to Aug. 20....	80	Aug. 20	42	Enteritis.....	

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
25	July 30	Milk and cream.	2	Sept. 25	57	Tuberculosis.....	Positive.
26	....do...	.....do.....	2	Nov. 18	111	Normal.....	
27	....do...	.....do.....	2	Nov. 23	116	.....do.....	

SECOND SERIES.

1423	Oct. 13	Milk.....	5	Dec. 22	70	Not tuberculosis.....	
1424	....do...	.....do.....	3	Dec. 19	67	.....do.....	
1425	Oct. 15	Cream.....	5	Jan. 5	82	Normal.....	
1426	....do...	.....do.....	3	Jan. 15	92	.....do.....	

Cow No. 16. St. Elizabeth herd.

Age, 10 years; condition, unthrifty; number of calves, 6; breed, Holstein; origin, raised.

Physical examination, September 25, 1900: Pulse, 46; respiration, 18; temperature, 101.1°. Glands: Submaxillary, normal; supramammary, normal. Lungs: Percussion, normal; auscultation, normal.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	101.1°	102.2°
9 a. m	101	102
12 m	100.8	103.5
3 p. m	101.2	105
6 p. m	102.1	103.5

Postmortem at experiment station, Bethesda, Md., November 23, 1901:[a] The mediastinal glands, which are enlarged, contain a few very small tubercular foci. The posterior portion of the principal lobe of the left lung solidified for a distance of 5 inches from the tip forward. Similar mass, about 4 inches in diameter, in the dorsal portion of this lung. Sprinkled throughout the lungs generally are a few tubercular foci about 1 inch in diameter. The material in these lesions is undergoing softening, and two or three pockets, containing softened tubercular material, are in direct communication with the bronchial tubes.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

[a] For the postmortem notes on cow No. 16 the writer is indebted to Dr. E. C. Schroeder, superintendent of experiment station, Bethesda, Md.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
22a	July 9 to Aug. 14 ...	80	Aug. 14	36	Not tubercular.....	
23a	July 9 to Sept. 25 ...	80	Nov. 15	129	.....do.....	
24a	July 9 to Aug. 31 ...	80	Aug. 31	53	.....do.....	

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
29	July 30	Milk and cream.	2	Sept. 8	40	Not tubercular.....	
30	....do...	....do.....	2	Nov. 5	98	No lesions apparent..	

SECOND SERIES.

Cow at the experiment station when the second test was made.

Cow No. 17. St. Elizabeth herd.

Age, 8 years; condition, good; number of calves, 3; breed, common; origin, bought 4 years ago.

Physical examination, October 25, 1900: Pulse, 36; respiration, 22; temperature, 100.6°. Superficial lymph glands, normal. Lungs, normal.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	101.1°	101.7°
9 a. m	101.1	102.7
12 m	100.8	105.3
3 p. m	101	105.3
6 p. m	102.5	105.2

Postmortem, Rosslyn, Va., February 1, 1901: Five tuberculous foci in posterior mediastinal glands from one-eighth to one-fourth inch in diameter and of a caseous nature. Several tubercular areas on dorsal border of caudal lobe of right lung size of a shellbark to a hen's egg. They have undergone caseous changes and show a tendency to coalesce. Liver contains a large abscess, not tubercular.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
161a	July 30 to Oct. 9	80	Nov. 9	102	No lesions	
162a	.....do	80	Nov. 30	123	.....do.....	
163a	.....do	80	Nov. 14	107	.....do.....	

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
192	Aug. 30	Milk	3	Oct. 24	55	No lesions	
193	....do	.....do	2	Nov. 27	89	.....do	
194	....do	Cream	3	Nov. 22	84	.....do	
195	....do	.....do	2	Oct. 15	46	No apparent lesions	

SECOND SERIES.

1472	Oct. 16	Cream	3	Jan. 5	81	No lesions	
1473	....do	Milk	4	Dec. 13	58	.....do	
1474	....do	.....do	2	Jan. 12	88	.....do	

Cow No. 18. St. Elizabeth herd.

Age, 7 years; condition, good; number of calves, (?); breed, common; origin, bought 6 months before test.

Physical examination, October 25, 1900: Pulse, 44; respiration, 20; temperature, 101°; M. M., normal. Glands: Submaxillary, normal; supramammary, normal. Lungs: Percussion, right lung, clear, left lung, clear; auscultation, right lung, clear, left lung, clear.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	101.4°	102.4°
9 a. m	100.9	102.3
12 m	101	102.6
3 p. m	101.4	105.3
6 p. m	102	105.2

Postmortem, Rosslyn, Va., December 17, 1900: The posterior mediastinal glands are greatly enlarged and completely calcareous. The anterior mediastinal glands contain four necrotic foci from one-eighth to one-fourth inch in diameter. The bronchial glands are slightly increased in size and contain several caseous nodules from the size of a pea to a hazelnut.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis	Microscopic examination of lesions.
		c. c.				
137a	July 31 to Oct. 9	80	Nov. 12	104	Normal	
138a	.....do	80	Nov. 26	118	.....do	
139a	.....do	80	Dec. 14	136	.....do	

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
61	Aug. 4	Milk and cream.	3	Aug. 7	3	Pyemia	
62	....do	.....do	2	Oct. 3	60	Not tuberculosis	
63	....do	.....do	2	Nov. 12	100	No lesions	

SECOND SERIES.

1427	Oct. 13	Milk	5	Dec. 22	70	Normal	
1428	....do	.....do	3	Dec. 17	65	.....do	
1429	Oct. 15	Cream	5	Dec. 3	49	.....do	
1430	....do	.....do	3	Dec. 15	61	Enteritis	

Cow No. 19. St. Elizabeth herd.

Age, 8 years; condition, good; number of calves, 4; breed, grade Ayrshire; origin, raised.

Physical examination, January 3, 1901: Pulse, 44; respiration, 20; temperature, 100.1°. Superficial lymph glands, normal. Lungs: Percussion apparently clear; auscultation, right lung, apparently normal; left lung, intermittent mucous râles.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	100.6°	104.5°
9 a. m	101	106.5
12 m	101.7	105.9
3 p. m	101.3	105
6 p. m	102.2	104.3

Postmortem, Rosslyn, Va., February 1, 1901: Posterior portion of left caudal lobe is entirely consolidated and broken down. The cephalic lobe of right lung is one mass of caseous tubercular material. Bronchial and both mediastinal glands enlarged and completely degenerated. Prepectoral gland contains three miliary indurated foci. Mesenteric glands show foci in five or six nodes. Omentum and peritoneum covered by grape-like clusters of tubercular neoplasms. Trachea contains fourteen small tuberculous ulcers with suppurating surfaces.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
170a	July 9 to Oct. 9	80	Dec. 9	153	No lesions	
171a	.....do	90	Dec. 17	161	.....do	
172a	July 9 to Oct. 4	80	Oct. 4	87	Not tuberculosis	

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
92	Aug. 14	Milk	3	Oct. 22	69	No lesions	
93	....do	.....do	2	Dec. 1	109	.....do	
94	....do	Cream	3	....do	109	.....do	
95	....do	.....do	2	Sept. 8	25	Not tuberculosis	

SECOND SERIES.

1431	Oct. 13	Milk	3	Dec. 22	70	No lesions	
1432	....do	.....do	5	....do	70	.....do	
1433	....do	Cream	5	Dec. 6	54	.....do	
1434	....do	.....do	3	Dec. 17	65	.....do	

Cow No. 20. St. Elizabeth herd.

Age, 2½ years; condition, good; number of calves, 1; breed, Holstein; origin, raised. Physical examination, October 10, 1900: Pulse, 44; respiration, 21; temperature, 102°. Superficial lymph glands, normal. Lungs, normal.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	101.3°	103.8°
9 a. m	101.4	105.5
12 m	101.5	105.7
3 p. m	102.2	105.3
6 p. m	102.2	105.1

Postmortem, Benning, D. C., March 9, 1901: The posterior mediastinal glands contain seven or eight encapsulated foci from one-fourth to five-eighths inch in diameter that show a calcareous infiltration. Left ventral lobe is transformed into a solid tuberculous mass and contains a semicalcareous material. Right lung contains a few small caseous nodules in caudal lobe. Pleural adhesions present on both sides, but no excrescences observed.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
131a	July 9 to Oct. 9	80	Jan. 2	177	No lesions	
132a	.....do	80	Dec. 21	165	.....do	
133a	.....do	80	Nov. 12	126	.....do	

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
88	Aug. 14	Milk	3	Sept. 30	47	Not tuberculosis	
89	....do	....do	2	Sept. 25	42	....do	

SECOND SERIES.

1435	Oct. 13	Milk	5	Dec. 19	67	No lesions	
1436	....do	....do	3	Nov. 6	24	Not tuberculosis	
1437	....do	Cream	5	Dec. 20	68	No lesions	

Cow No. 64. St. Elizabeth herd.

Age, 5 years; condition, good; number of calves, 2; breed, Holstein; origin, bought 1½ years ago.

Physical examination, January 4, 1901: Pulse, 54; respiration, 20; temperature, 101.7°. Superficial lymph glands, normal. Lungs: Percussion, right lung, apparently normal; left lung, dullness along posterior superior border; ausculation, right lung, clear; left lung, mucous rales appearing intermittent.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	101.8°	105 °
9 a. m	101	105.4
12 m	101.4	106
3 p. m	101	106.2
6 p. m	101.1	105

Postmortem, at Fowlers, D. C., April 12, 1901: The principal lobe of left lung contains a cluster of tuberculous nodules covering an area 4 inches in diameter and leading into at least two bronchi. One small encysted focus in cephalic lobe of right lung. Posterior mediastinal glands contain several small tubercular foci from one-fourth to one-half inch in diameter and of a cheesy nature. Left pharyngeal gland is size of a hen's egg and on section shows a caseous change, with center calcareous. The mucous membrane of trachea presents 6 suppurating ulcers with irregular raised borders surrounded by a hyperemic zone. Liver contains several necrotic foci the size of a pea, of tuberculous nature.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
25a	July 9 to Oct. 9	80	Nov. 9	123	No lesions	
26a	....do	80	Dec. 12	156	....do	
27a	....do	80	Oct. 10	93	Not tuberculosis	

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
31	July 31	Milk and cream.	3	Sept. 29	60	Tuberculosis	Positive.
32	....do	.....do	2	Oct. 27	88	No lesions	
33	....do	.....do	2	Nov. 17	109	.....do	

SECOND SERIES.

1476	Oct. 15	Milk	4	Dec. 18	64	No lesions	
1477	....do	.....do	3	Nov. 15	31	Tuberculosis	Positive.
1478	....do	Cream	3	Dec. 15	61	No lesions	
1479	....do	.....do	5	Nov. 24	40	Tuberculosis	Do.

Cow No. 65. St. Elizabeth herd.

Age, 8 years; condition, unthrifty; number of calves, 3; breed, Holstein; origin, bought in Virginia one year ago.

Physical examination, September 11, 1900: Pulse, 57; respiration, 36; temperature, 102.9°. Glands: Right submaxillary, enlarged; supramammary, normal. Lungs: Percussion, right lung, dullness right posterior border; left lung, normal; auscultation right lung, mucous râles, with areas of silence; left lung, mucous râles.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	101.2°	102.2°
9 a. m	101.9	103.6
12 m	100.5	105.8
3 p. m	102	104.3
6 p. m	102.2	103.3

Postmortem, Rosslyn, Va., December 11, 1900: All the lobes of both lungs show advanced tuberculosis, several abscesses being in direct communication with the bronchi in the right caudal lobe. The bronchial glands are the size of a hen's egg and entirely caseated. The anterior and posterior mediastinal glands are greatly enlarged, the caudal node being the size of one's fist, the others in proportion, and all being calcareous on section. The right submaxillary, the prepectoral, the lumbar, the left deep inguinal, the portal, and almost the entire chain of mesenteric glands show more or less degenerated tuberculous foci. The pleura and peritoneum are covered with tubercular neoplasms (pearl disease), which are also found on the pericardium and on the serous covering of the bladder, liver, spleen, and stomach. The liver contains a semicalcareous area the size of a hen's egg. The left kidney shows three encysted tuberculous foci, one-third to three-fourths inch in diameter and of a caseous nature.

Microscopic examination of centrifugal sediment of milk, positive; of cream, positive.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
28a	July 9 to Aug. 29 ...	80	Aug. 29	51	Tuberculosis.....	Positive.
29a	July 9 to Aug. 22 ...	80	Aug. 22	44	.....do.....	Do.
30a	July 9 to Oct. 9.....	80	Oct. 30	113	.....do.....	Do.

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
34	July 31	Milk and cream.	3	Aug. 12	12	Pneumonia.....	Negative.
35	....do...	.....do.....	2	Aug. 8	8	Subacute peritonitis..	

SECOND SERIES.

1480	Oct. 16	Cream	5	Dec. 23	68	No lesions	
1481	....do...	.....do.....	3	Nov. 10	25	Tuberculosis	Positive.
1482	....do...	Milk.....	5	Nov. 28	43	.....do	Do.
1483	....do...	.....do.....	3	Dec. 28	73	No lesions	

Cow No. 66. St. Elizabeth herd.

Age, 7 years; condition, poor; number of calves, 3; breed, Holstein; origin, raised.

Physical examination, October 10, 1900: Pulse, 40; respiration, 20; temperature, 101.9° Superficial lymph glands, normal. Lungs, normal.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	102°	102. 6°
9 a. m	101. 1	104. 2
12 m	100. 1	106. 5
3 p. m	100. 9	107. 2
6 p. m	101. 2	106. 6

Postmortem, Rosslyn, Va., December 11, 1900: Small tuberculous focus one-half inch in diameter in apex of cephalic lobe of right lung. Over the pleural surface of left lung are numerous isolated and confluent grape-like excrescences, while the parietal pleura shows a few scattered clusters. Both bronchial, anterior and posterior mediastinal, and the prepectoral glands all show miliary foci of tuberculosis.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
31a	July 9 to Oct. 9	120	Nov. 8	122	No lesions.....	
32a	.....do	120	Nov. 17	131	.....do.....	

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
37	July 31	Milk and cream	3	Nov. 30	122	No lesions	
38	....do	.....do	2	Nov. 26	118	.....do	
39	....do	.....do	2	Oct. 4	65	.....do	

SECOND SERIES.

1470	Oct. 16	Cream	3	Jan. 4	80	No lesions	
1471	....do	Milk	5	Nov. 19	34	Not tuberculosis	
1485	....do	.....do	3	Jan. 25	101	No lesions	
1486	....do	Cream	5	Jan. 12	88	.....do	

Cow No. 67. St. Elizabeth herd.

Age, 4 years; condition, good; number of calves, 2; breed, Holstein; origin, raised.

Physical examination, September 11, 1900: Pulse, 52; respiration, 26; temperature, 101.5°. Superficial lymph glands, normal. Lungs, apparently normal.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	100.4°	106.7°
9 a. m	101.2	105.6
12 m	101.2	106.2
3 p. m	101.8	106.1
6 p. m	102.2	105.1

Postmortem, Benning, D. C., March 8, 1901: In posterior portion of both principal lobes are several caseous nodules from one-half to 1¼ inches in diameter. The ventral lobe of right lung contains four tuberculous areas that are partly broken down. Posterior mediastinal glands enlarged and contain six small calcareous foci varying in size from a hemp seed to that of a pea.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
33a	July 9 to Oct. 9	80	Jan. 1	176	No lesions	
34a	.....do	80	Nov. 24	138	.....do	
35a	.....do	80	Nov. 13	127	.....do	

Inoculation experiments.

FIRST SERIES

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
40	July 31	Milk and cream.	3	Oct. 5	66	No lesions	
41	....do	.....do	2	Oct. 1	62	.....do	
42	....do	.....do	2	Oct. 27	88	.....do	

SECOND SERIES.

1467	Oct. 15	Milk	3	Nov. 15	31	No evidence of tuberculosis.	
1468	....do	Cream	3	Oct. 31	16	.....do	
1469	....do	.....do	5	Nov. 20	36	.....do	

Cow No. 68. St. Elizabeth herd.

Age, 8 years; condition, good; number of calves, 3; breed, Jersey; origin, bought 4 years ago.

Physical examination, October 25, 1900: Pulse, 44; respiration, 22; temperature, 101.3°. Glands: Left submaxillary, the size of a walnut; supramammary, normal. Lungs: Percussion, normal; auscultation, normal.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	101.4°	106.6°
9 a. m	100.9	104.1
12 m	101	104
3 p. m	101.2	102.4
6 p. m	102	102

Postmortem, Rosslyn, Va., December 11, 1900: Caudal lobe of left lung contains, on its dorsal border, one tubercle the size of a horse-chestnut. On section it is seen to have undergone caseous necrosis. The cephalic lobe of this lung has two pea-size nodules that are likewise cheesy in consistence. The right principal lobe shows two degenerated foci the size of chestnuts located near the apex and on section are found to be of a caseo-calcareous nature. Left submaxillary gland is slightly enlarged and on section shows 4 soft, yellowish tubercles. The caudal node of the posterior mediastinal glands is the size of a hen's egg and transformed into yellow cheesy detritus.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
36a	July 9 to Oct. 9	80	Nov. 23	137	Not tuberculosis	
37a	.....do	80	Nov. 15	129	.....do	
38a	.....do	80	Nov. 18	132	.....do	

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Portmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
43	Aug. 1	Milk and cream.	3	Dec. 21	142	No lesions	
44	....do	.....do	2	Sept. 28	58	Not tuberculosis	
45	....do	.....do	2	Dec. 3	124	No lesions	
		SECOND SERIES.					
1461	Oct. 18	Milk	3	Nov. 5	18	Not tuberculosis	
1463	....do	Cream	3	Dec. 13	56	No lesions	
1464	....do	.....do	5	Nov. 17	30	Not tuberculosis	
1465	....do	Milk	5	Nov. 2	15	Hepatic abscess	Negative.

Cow No. 70. St. Elizabeth herd.

Age, 6 years; condition, good; number of calves, 3; breed, Holstein; origin, raised.

Physical examination, September 11, 1900: Pulse, 44; respiration, 23; temperature, 103.1°. Superficial lymph glands, normal. Lungs, normal.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	102.4°	102.6°
9 a. m	102	102
12 m	102.1	102
3 p. m	102.1	102.8
6 p. m	101.9	104.3
9 p. m		103.9

Postmortem, Fowlers, D. C., May 11, 1901: Ventral lobe of right lung shows three or four encapsuled tuberculous nodules from one-half to three-fourths inch in diameter. One small caseous focus in the caudal node of the posterior mediastinal gland. One mesenteric gland contains a necrotic focus of tuberculous origin one-eighth inch in diameter.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
39a	July 9 to Oct. 9	80	Oct. 9	91	Not tuberculosis	
40a	.....do	80	Nov. 21	135	.....do	
41a	.....do	80	Nov. 12	126	.....do	

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Inoculation experiments

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
46	Aug. 1	Milk and cream	3	Nov. 25	116	No lesions	
47	....do	.....do	2	Oct. 14	74	.....do	
48	....do	.....do	3	Nov. 14	105	.....do	

SECOND SERIES.

1487	Oct. 18	Milk	5	Nov. 9	22	Not tuberculosis	
1488	....do	.....do	3	Nov. 22	35	.....do	
1489	....do	Cream	5	Jan. 10	84	No lesions	
1490	....do	.....do	3	Jan. 13	87	.....do	

Cow No. 71. St. Elizabeth herd.

Age, 8 years; condition, fair; number of calves, 4; breed, grade Ayrshire; origin, raised.

Physical examination, November 27, 1900: Pulse, 45; respiration, 21; temperature, 102.1. Superficial lymph glands, normal. Lungs: Percussion, right lung, normal; left lung, posterior lobe gives a muffled sound; auscultation, right lung, apparently normal; left lung, mucous râles.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	101.9°	102.4°
9 a. m	100.2	103.1
12 m	101.3	106.1
3 p. m	101.9	107.4
6 p. m	102.4	106.3

Postmortem, Rosslyn, Va., December 11, 1900: Right principal lobe contains many caseous foci that have not coalesced, varying in size from a pea to a shellbark. Left lung contains pus cavities in the center of principal lobe. Cephalic lobe has three caseo-calcareous areas the size of walnuts. Trachea contains five or six tuberculous ulcers on mucous membrane from three-eighths to three-fourths inch in diameter. Anterior mediastinal glands normal in size, but contain several small yellow caseous tubercles. Posterior mediastinal, left retropharyngeal, and one mesenteric gland are enlarged, and on section show cheesy degeneration.

Microscopical examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
42a	July 9 to Aug. 12....	80	Aug. 12	34	Pneumonia	Negative.
43a	July 9 to Sept. 30 ...	80	Sept. 30	83	Tuberculosis	Positive.
44a	July 9 to Sept. 20 ...	80	Sept. 20	73	.....do	Do.

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
49	Aug. 2	Milk and cream.	3	Aug. 5	3	Peritonitis	
50	....do	.....do	3	Oct. 27	86	No lesions	
51	....do	.....do	3	Nov. 5	95	.....do	

SECOND SERIES.

1491	Oct. 18	Milk	5	Dec. 22	65	No lesions	
1492	....do	Cream	5	Nov. 23	36	Tuberculosis	Positive.
1493	....do	Milk	3	Dec. 15	58	No lesions	
1494	....do	Cream	3	Dec. 14	57	Tuberculosis	Do.

Cow No. 72. St. Elizabeth herd.

Age, 7 years; condition, good; number of calves, 3; breed, Holstein; origin, bought two years ago.

Physical examination, September 11, 1900: Pulse, 50; respiration, 20; temperature, 102.3°. Submaxillary glands, enlarged and indurated; supramammary glands, normal. Lungs, normal.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	100.1°	103°
9 a. m	100.8	106.4
12 m	101	107
3 p. m	102	106
6 p. m	101.8	103.3

Postmortem: Animal died suddenly October 23, 1900, at the asylum, and was buried without a postmortem examination being made.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
113a	July 9 to Oct. 9	80	Jan. 2	177	No lesions	
114a	.....do	80	Dec. 10	154	.....do	
115a	.....do	80	Aug. 15	37	Enteritis	

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
52	Aug. 2	Milk and cream.	3	Nov. 5	95	No lesions	
53	....do	.....do	3	Nov. 2	92	.....do	

Inoculation experiments—Continued.

SECOND SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
1495	Oct. 18	Cream	5	Dec. 17	60	No lesions	
1496	....do	.....do	3	Nov. 13	26	Not tuberculosis	
1497	....do	Milk	5	Dec. 21	64	No lesions	
1498	....do	.....do	3	Dec. 19	62	.....do	

Cow No. 73. St. Elizabeth herd.

Age, 4 years; condition, good; number of calves, 2; breed, Holstein; origin, raised.

Physical examination, October 10, 1900: Pulse, 45; respiration, 23; temperature, 103.1°. Narrow chest. Submaxillary gland, enlarged; supramammary gland, normal. Lungs: Percussion, normal; auscultation, normal.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	100.6°	102.2°
9 a. m	101.2	102
12 m	101.3	103.8
3 p. m	102.9	104.2
6 p. m	102.3	104.2

Postmortem, Rosslyn, Va., December 11, 1900: Right principal lobe of lung has area size of an egg containing caseous and semifluid material and a number of smaller foci with similar contents. Apex of left lung completely solidified with cheesy tuberculous mass. Anterior and posterior mediastinal, bronchial, right submaxillary, and right and left retro-pharyngeal glands all show small necrotic foci from one-fourth to three-fourths inch in diameter. Five mesenteric glands contain nodules of caseous material. Left kidney shows retention cysts.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
45a	July 9 to Oct. 7	80	Oct. 7	90	Tuberculosis	Positive.
46a	July 9 to Sept. 15	80	Sept. 15	68	.....do	do
47a	July 9 to Oct. 9	80	Dec. 20	164	No lesions	

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
54	Aug. 3	Milk and cream	3	Nov. 20	109	No lesions	
55	....do	.....do	3	Sept. 4	32	Not tubercular	
56	....do	.....do	2	Sept. 11	39	.....do	
57	....do	.....do	2	Sept. 25	53	.....do	

Inoculation experiments—Continued.

SECOND SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
1499	Oct. 18	Milk	5	Nov. 19	32	Tuberculosis	Positive.
1500	....do....	Cream	5	Dec. 15	58	No lesions	
1501	....do....	Milk	3	Dec. 14	57	.....do	
1502	....do....	Cream	3	Nov. 15	28	Pneumonia	Negative.

Cow No. 74. St. Elizabeth herd.

Age, 4 years; condition, fairly good; number of calves, 1; breed, grade Holstein; origin, raised.

Physical examination, September 11, 1900: Pulse, 46; respiration, 22; temperature, 102.3°. Glands: Submaxillary, normal; supramammary, normal. Lungs: Percussion, normal; auscultation, normal.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	103.2°	108°
9 a. m	103.1	105
12 m	103.1	106.2
3 p. m	103	104.4
6 p. m	102.6	105.1

Postmortem, experiment station, Bethesda, Md., November 23, 1901:[a] Lungs: Posterior half of both principal lobes affected with tuberculosis. These lobes contain numerous cavities in communication with the bronchi. The right lobe contains one very large pocket, 4 by 6 inches in area. The cavities all contain more or less broken-down, pus-like, tubercular material. A similar but smaller cavity 1 inch in diameter in left cephalic lobe. Mediastinal glands enlarged and tubercular. Glands at base of tongue greatly enlarged and converted into tubercular material, which is very much softened. Liver: Sprinkled on surface and scattered through the parenchyma are tubercular nodules, verying in size from a pea to several inches in diameter. In some places the nodules have become confluent, forming tubercular masses 5 to 6 inches in diameter. Portal glands greatly enlarged, entirely tubercular and undergoing softening. The tubercular material in the liver varies from firm nodules to soft material which, on incision, flows like semifluid pus. Mesenteric glands show occasional tubercular lesions.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
49a	July 9 to Aug 17	80	Aug. 17	39	No apparent lesions	
50a	July 9 to Sept. 20	80	Sept. 20	73	Tuberculosis	Positive.
51a	July 9 to Oct. 9	80	Dec. 17	161	No lesions	

[a] For the postmortem notes on cow No. 74, the writer is indebted to Dr. E. C. Schroeder, superintendent of experiment station, Bethesda, Md.

Inoculation experiment.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
58	Aug. 3	Milk and cream.	3	Nov. 19	108	No lesions	
59	....do	.....do	2	....do	108	.....do	
60	....do	.....do	2	Sept. 6	34	Pneumonia	Negative.

SECOND SERIES.

Cow at the experiment station when the second test was made.

Cow No. 75. St. Elizabeth herd.

Age, 14 years; condition, rather poor; number of calves, 8; breed, grade Ayrshire; origin, raised.

Physical examination, October 18, 1900: Pulse, 32; respiration, 20; temperature, 101.6°. Superficial lymph glands, normal. Lungs, normal.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	102.6°	105°
9 a. m	102.4	104.8
12 m	102.9	105.2
3 p. m	102.3	102.7
6 p. m	102.4	102.4

Postmortem, Rosslyn, Va., February 5, 1901: Anterior mediastinal gland contains few tuberculous nodules. Right bronchial gland greatly enlarged, and on sectioning the contents are seen to be gritty. Posterior border of both caudal lobes of lungs contain several caseous foci size of beans. One caseous nodule in a mesenteric gland.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
51a	July 9 to Aug. 19	80	Aug. 19	41	Not tuberculosis	
52a	July 9 to Oct. 9	80	Dec. 2	146	No lesions	
53a	July 9 to Aug. 7	80	Aug. 7	29	Not tuberculosis	

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
64	Aug. 6	Milk and cream.	3	Sept. 3	28	Abscess at seat of inoculation.	Negative.
65	....do	.....do	2	Oct. 12	67	No lesions	
66	....do	.....do	2	Oct. 22	77	.....do	

Inoculation experiments—Continued.

SECOND SERIES.

Guinea pig No.	Date of injection	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
1503	Oct. 18	Cream	3	Jan. 11	85	No lesions	
1504	....do	Milk	3	Dec. 11	54	....do	
1505	....do	Cream	5	Nov. 25	38	Pneumonia	

Cow No. 76. St. Elizabeth herd.

Age, 4 years; condition, good; number of calves, 1; breed, Holstein; origin, raised. Physical examination, October 18, 1900: Pulse, 32; respiration, 12; temperature, 101.5°. Superficial lymph glands, normal. Lungs, normal.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	101.2°	103.6°
9 a. m	101.6	102.4
12 m	101.6	104
3 p. m	101.5	105.6
6 p. m	102.4	103.6

Postmortem, Benning, D. C., March 8, 1901: Five small calcareous nodules in posterior mediastinal glands. Posterior pharyngeal glands are enlarged and show three or four calcareous foci in each, about one-fourth inch in diameter.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
54a	July 9 to Oct. 9	80	Oct. 28	111	Not tuberculosis	
55a	.....do	80	Oct. 18	101	.....do	
56a	July 9 to Sept. 16	80	Sept. 16	69	.....do	

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection	Material.	Dose injected.	Date when killed or died	Number of days alive.	Postmortem diagnosis	Microscopic examination of lesions.
			c. c.				
67	Aug. 7	Milk and cream.	3	Sept. 12	36	Not tuberculosis	
68	....do	.....do	2	Sept. 21	45	.....do	
69	....do	.....do	2	Aug. 23	16	.....do	

SECOND SERIES.

1507	Oct. 18	Cream	5	Dec. 17	60	No lesions	
1508	....do	Milk	5	Nov. 8	21	Abscess at point of injection, with pyemia.	Negative.

Cow No. 77. St. Elizabeth herd.

Age, 7 years; condition, fair; number of calves, 4; breed, Jersey; origin, raised.

Physical examination, February 4, 1901: Pulse, 46; respiration, 22; temperature, 101.1°. Superficial lymph glands, normal. Lungs: Percussion, right lung, dullness; left lung, normal; auscultation, right lung, mucous râles; left lung, normal.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m.	100.5°	102.4°
9 a. m.	101	105.3
12 m.	101	106
3 p. m.	100.8	106
6 p. m.	101.4	105.3

Postmortem, Fowlers, D. C., June 4, 1901: The posterior pharyngeal, the bronchial, and the anterior and posterior mediastinal glands are all enlarged and degenerated with caseous contents. The caudal and ventral lobes of left lung show five or six nodules from the size of a shellbark to a walnut that contain partly broken-down material. In the posterior portion of right caudal lobe several tubercular foci have coalesced, forming one large irregular tuberculous mass which appears to be separated from the normal lung tissue by a retaining band of fibrous tissue. The prepectoral glands are enlarged and edematous, but do not show any foci. The parietal pleura, the anterior surface of the diaphragm, portions of the peritoneum, and posterior surface of the liver are studded with numerous tubercles of varying size, forming the so-called "pearl disease." Five or six mesenteric glands show caseous nodules from one-sixteenth to one-fourth inch in diameter.

Microscopic examination of centrifugal sediment of milk, positive; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
57a	July 9 to Sept. 12....	120	Sept. 12	65	Tuberculosis.....	Positive.
58a	July 9 to Sept. 8.....	120	Sept. 8	61	.....do	Do.

Inoculation experiments.

FIRST SERIES

Guinea pig No.	Date of injection.	Material	Dose injected.	Date when killed or died	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
70	Aug. 8	Cream.....	3	Aug. 12	4	Pneumonia.....	
71	....do	.....do.....	2	Nov. 16	100	No lesions.....	
72	....do ...	Milk.....	2	Oct. 3	56	Tuberculosis	Positive.

SECOND SERIES.

Cow dry.

Cow No. 78. St. Elizabeth herd.

Age, 9 years; condition, good; number of calves, 4 or 5; breed, common; origin, bought five years ago.

Physical examination, September 26, 1900: Pulse, 38; respiration, 18; temperature, 101.2°. Superficial lymph glands, normal. Lungs: Examination unsatisfactory, owing to nervous temperament of animal.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	101.5°	102°
9 a. m	101.6	101.3
12 m	101.4	103.4
3 p. m	101	104.3
6 p. m	101.8	103.3

Postmortem, Rosslyn, Va., December 17, 1900: Generalized miliary tuberculosis invades all the lobes of the lungs. Prepectoral and suprasternal glands are slightly enlarged and contain caseous foci from one-eighth to three-eighths inch in diameter. Peritoneum and spleen covered with tubercular excrescences of a nature indicative of recent infection. Six or seven glands in mesenteric chain are affected, several showing calcareous deposits.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
60a	July 9 to Sept. 12....	80	Sept. 12	65	Not tuberculosis	
61a	July 9 to Oct. 9.....	80	Nov. 25	139	No lesions.....	
62a	July 9 to Sept. 24....	80	Sept. 24	77	Not tuberculosis	

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
73	Aug. 9	Milk.....	3	Nov. 17	100	Normal.....	
75	....do...	.....do	2	Sept. 16	38	Not tuberculosis.....	
78	....do...	Cream.....	3	Sept. 7	29	Abscess at point of inoculation.	Negative.

SECOND SERIES.

Cow dry.

Cow No. 79. St. Elizabeth herd.

Age, 6 years; condition, poor; number of calves, (?); breed, Jersey; origin, bought three years ago.

Physical examination, October 18, 1900: Pulse, 42; respiration, 16; temperature, 102.4°. Superficial lymph glands, normal. Lungs, normal.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	101.6°	101.7°
9 a. m	102.3	103
12 m	101.4	105.3
3 p. m	101.2	105.7
6 p. m	101.2	102.9

Postmortem, Rosslyn, Va., February 5, 1901: Posterior mediastinal glands show two small foci of a semicalcareous nature. Lower border of ventral lobe of right lung contains a tuberculous area the size of a walnut. Left lung has a small tuberculous focus of putty-like consistency in ventral lobe size of a bean.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
63a	July 9 to Aug. 29	80	Aug. 29	51	Not tuberculosis	
64a	July 9 to Aug. 21	80	Aug. 21	43	do	
65a	July 9 to Aug. 10	80	Aug. 10	32	do	
66a	July 9 to Aug. 19	80	Aug. 19	41	do	

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
76	Aug. 10	Milk and cream.	3	Sept. 14	35	Not tuberculosis	
77	do	do	2	Sept. 21	42	do	

SECOND SERIES.

1519	Oct. 18	Cream	3	Nov. 16	29	Not tuberculosis	
1520	do	Milk	3	Dec. 6	49	No lesions	
1521	do	do	5	Dec. 19	62	do	
1522	do	Cream	5	Oct. 31	18	Hepatic abscess	

Cow No. 80. St. Elizabeth herd.

Age, 9 years; condition, poor; number of calves, 4; breed, Holstein; origin, bought three years ago.

Physical examination, September 11, 1900: Pulse, 54; respiration, 18; temperature, 101.9°. Glands: Left submaxillary, enlarged; supramammary, normal. Tumor size of a goose egg on right flank above mammary gland. Lungs, normal.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	101.6°	102.2°
9 a. m	101.4	101.3
12 m	101.2	104.6
3 p. m	102	105.7
6 p. m	102.4	105

Postmortem, Rosslyn, Va., December 21, 1900: Two tuberculous nodules in apex of left lung size of shellbarks. The same number of slightly larger areas are present in the principal lobe of left lung. Left submaxillary, left bronchial and posterior mediastinal glands show miliary foci undergoing necrotic changes.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Portmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
67a	July 9 to Oct. 9.....	80	Dec. 1	145	No lesions.....	
68a	.....do.....	80	Dec. 21	165	.....do.....	
69a	.....do.....	80	Oct. 10	93	Pneumonia.....	

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
80	Aug. 11.	Cream.....	3	Sept. 7	27	Not tuberculosis.....	
81	....do...	.....do.....	2	Oct. 29	79	No lesions.....	
82	....do...	Milk.....	3	Sept. 3	23	Not tuberculosis.....	
83	....do...	.....do.....	2	Sept. 8	28	.....do.....	

SECOND SERIES.

1549	Oct. 18	Milk.....	5	Dec. 15	58	No lesions.....	
1550	....do...	Cream.....	5	Dec. 18	61	.....do.....	
1551	....do...	Milk.....	3	Dec. 15	58	.....do.....	
1552	....do...	Cream.....	3	Nov. 12	25	Not tuberculosis.....	

Cow No. 81. St. Elizabeth herd.

Age, 6 years; condition, good; number of calves, (?); breed, common; origin, bought 6 months before test.

Physical examination, September 10, 1900: Pulse, 38; respiration, 22; temperature, 101.8°. Superficial lymph glands, normal. Lungs, normal.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	102.9°	106.4°
9 a. m	102.3	106
12 m	102	105.8
3 p. m	102.8	105.2
6 p. m	103	104.5

Postmortem, Rosslyn, Va., February 5, 1901: Left posterior pharyngeal gland size of a hen's egg, and appears as a yellowish calcareous mass. Two hemp-seed foci in right bronchial gland. Caudal node of posterior mediastinal gland, small necrotic focus. One caseous nodule the size of a walnut in apex of right lung. Both lungs are adherent to the diaphragm by hypertrophied connective tissue.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
70a	July 9 to Oct. 9.....	80	Dec. 13	157	Not tuberculosis.....	
71a	.....do.....	80	....do...	157	Normal.....	
72a	.....do.....	80	....do...	157	.....do.....	

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
84	Aug. 12	Cream.....	3	Nov. 20	100	Normal.....	
85	....do...	.....do.....	2	Oct. 27	76	.....do.....	
86	....do...	Milk.....	3	....do...	76	.....do.....	
87	....do...	.....do.....	3	Nov. 20	100	.....do.....	

SECOND SERIES.

1555	Oct. 20	Cream.....	5	Oct. 26	6	Peritonitis.....	
1556	....do...	.....do.....	3	Dec. 14	55	Normal.....	
1557	....do...	Milk.....	3	....do...	55	.....do.....	
1558	....do...	.....do.....	5	Dec. 31	72	.....do.....	

Cow No. 83. St. Elizabeth herd.

Age, 12 years; condition, good; number of calves, 8; breed, Ayrshire; origin, raised.

Physical examination, October 18, 1900: Pulse, 46; respiration, 18; temperature, 101.2°. Superficial lymph glands, normal. Lungs, normal.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	101.4°	103.6°
9 a. m	101.6	104.8
12 m	101.8	105.6
3 p. m	102.2	104
6 p. m	102.6	103.2

Postmortem, Benning, D. C., March 19, 1901: Caudal lobe of right lung shows three nodules the size of hazel nuts with caseous contents. In the cephalic lobe of left lung several tuberculous nodules have coalesced, and with the exception of the extreme apex this entire lobe is affected. Small calcified nodules size of hemp seed in one of the mesenteric glands.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
134a	July 9 to Oct. 9	80	Dec. 13	157	No lesions	
135a	do	80	Dec. 27	171	do	
136a	do	80	Dec. 26	170	do	

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
196	Aug. 30	Milk	3	Sept. 22	23	Not tuberculosis	
197	do	do	2	Nov. 22	84	No lesions	
198	do	Cream	3	Nov. 19	81	do	
199	do	do	2	Sept. 11	12	Pneumonia	

SECOND SERIES.

1559	Oct. 19	Milk	5	Dec. 4	46	Not tuberculosis	
1560	do	do	3	Dec. 15	57	No lesions	
1561	do	Cream	5	Dec. 21	63	do	
1562	do	do	3	Dec. 17	59	do	

Cow No. 85. St. Elizabeth herd.

Age, 6 years; condition, good; number of calves, (?); breed, common; origin, bought six months before test.

Physical examination, October 18, 1900: Pulse, 30; respiration, 17; temperature, 101.5°. Superficial lymph glands, normal. Lungs: Percussion, normal; auscultation, normal.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	101.8°	102.2°
9 a. m	102.1	102.3
12 m	101.3	104
3 p. m	101.6	103.4
6 p. m	101.7	104.3

Postmortem, at experiment station, November 13, 1901:[a] Mediastinal glands greatly enlarged and filled with areas of broken-down tubercular material. Lungs: One small focus of tuberculosis in the middle of the right principal lobe, about one-fourth inch in diameter.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

[a] For the postmortem notes on cow No. 85 the writer is indebted to Dr. E. C. Schroeder, superintendent of experiment station, Bethesda, Md.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
140a	July 9 to Aug. 30....	80	Aug. 30	52	Hepatic abscess.....	Negative.
141a	July 9 to Oct. 9.....	80	Oct. 10	98	Not tubercular.....	
142a	.....do.....	80	Oct. 25	108	.....do.....	

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
184	Aug. 29	Milk.....	3	Sept. 3	5	Peritonitis.....	Negative.
185	....do...	.....do.....	2	Sept. 6	8	Pyemia.....	Do.
186	....do...	Cream.....	3	....do...	8	.....do.....	Do.
187	....do...	.....do.....	2	Sept. 1	3	Peritonitis.....	

SECOND SERIES.

1563	Oct. 19	Milk.....	5	Oct. 30	11	Pseudo-tuberculosis..	Acid proof bacillus.
1568	....do...	.....do.....	3	Nov. 6	18	.....do.....	Do.
1565	Oct. 20	Cream.....	5	Dec. 22	63	No lesions.....	
1566	....do...	.....do.....	3	Nov. 16	27	Pseudo-tuberculosis..	Do.

Cow No. 86. St. Elizabeth herd.

Age, 7 years; condition, fairly good; number of calves, (?): Aborted 8-months' calf, June 3, 1900. Breed, common; origin, bought in Virginia six months before test.

Physical examination, October 18, 1900: Pulse, 38; respiration, 20; temperature, 101°. Superficial lymph glands, normal. Lungs: Percussion, normal; auscultation, normal.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	101.5°	101.6°
9 a. m	101.2	101.2
12 m	101	103.8
3 p. m	101.2	104.3
6 p. m	101	103

Postmortem, Rosslyn, Va., February 8, 1901: Posterior mediastinal glands contain several small foci of caseous material the size of a pea. The bronchial glands are enlarged to the size of a hen's egg and contain a caseous mass, with slight tendency to calcification in the center.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
143a	July 9 to Oct. 9.....	80	Nov. 2	116	No lesions	
144a	July 9 to Aug. 18 ...	80	Aug. 18	40	Not tubercular.....	
145a	July 9 to Sept. 14 ...	80	Sept. 14	67	.....do	

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
188	Aug. 29	Milk.....	3	Oct. 31	63	No lesions.....	
189	....do...	.....do	2	Aug. 31	2	Septicemia	
190	....do...	Cream	3	Nov. 20	83	No lesions	

SECOND SERIES.

1564	Oct. 19	Milk.....	3	Nov. 16	28	Not tubercular	
1567	....do...	.....do	5	Dec. 21	63	No lesions	
1568	....do...	Cream	3	Jan. 9	82	.....do	
1569	....do...	....do	5	Jan. 11	84	.....do	

Cow No. 87. St. Elizabeth herd.

Age, 4 years; condition, fair; number of calves, 2; breed, grade Holstein; origin, raised.

Physical examination, October 25, 1900: Pulse, 38; respiration, 18; temperature, 100.6°. Superficial lymph glands, normal. Lungs, normal.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m.....	100.1°	103.3°
9 a. m.....	100.8	106.3
12 m	101	106
3 p. m.....	101	105.9
6 p. m.....	101.7	104.9

Postmortem, Benning, D. C., March 19, 1901: The right posterior pharyngea gland is of normal size, but contains three miliary foci with contents of a gritty nature. The posterior mediastinal glands show three or four foci one-third to one-half inch in diameter, firmly encapsulated and completely calcified.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
146a	July 9 to Oct. 9.....	80	Jan. 3	178	Normal	
147a	.....do	80	Dec. 11	155	.....do.....	
148a	.....do	80	....do...	155	.....do.....	

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
176	Aug. 28	Milk	3	Oct. 31	64	Normal	
177	....do	.....do	2	Nov. 3	68	.....do	
178	....do	Cream	3	Nov. 4	69	.....do	
179	....do	.....do	2	....do	69	.....do	

SECOND SERIES.

1571	Oct. 19	Milk	3	Dec. 21	63	Normal	
1572	....do	.....do	5	Dec. 17	59	.....do	
1573	Oct. 20	Cream	5	....do	58	.....do	
1574	....do	.....do	3	Jan. 14	86	.....do	

Cow No. 88. St. Elizabeth herd.

Age, 5 years; condition, fair; number of calves, 2; breed, Jersey grade; origin, bought six months before test in Virginia.

Physical examination, October 25, 1900: Pulse, 50; respiration, 24; temperature, 101.7°. Superficial lymph glands, normal. Lungs, normal.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	101.2°	102.2°
9 a. m	101.8	105.9
12 m	100.8	106.2
3 p. m	101	106.3
6 p. m	101.8	105.8

Postmortem, Asylum, November 25, 1900: Aborted November 23; death due to puerperal septicemia. Caseous focus size of an acorn in ventral lobe of right lung. The same lobe of left lung shows several foci of a caseo-calcareous consistency. Anterior and posterior mediastinal glands show recent infection of miliary tuberculosis. Posterior pharyngeal glands similarly affected. Liver shows many angiomata. Uterus contains decomposed placenta and muco-sanguinolent fluid. Spleen pulp soft and tarry.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
149a	July 9 to Oct. 9	120	Dec. 1	145	No lesions	
151a	.....do	120	Dec. 24	168	.....do	

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
180	Aug. 28	Milk	3	Oct. 31	65	No lesions	
181	do	do	2	Nov. 5	70	do	
182	do	Cream	3	Nov. 4	69	do	
183	do	do	2	Nov. 5	70	do	

SECOND SERIES.

Cow dry.

Cow No. 89. St. Elizabeth herd.

Age, 5 years; condition, good; number of calves, 2; breed, grade Holstein; origin, raised.

Physical examination, October 18, 1900: Pulse, 44; respiration, 22; temperature, 101.9°. Glands: Submaxillaries, large as walnuts and indurated; supramammary, normal. Lungs: Percussion, apparently normal; auscultation, apparently normal.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	101.7°	103.2°
9 a. m	101.2	105
12 m	100.2	105.8
3 p. m	101.4	105.8
6 p. m	102.1	105.7

Postmortem, Rosslyn, Va., February 5, 1901: The caudal lobe of left lung contains a large irregular mass of tuberculous material 4 by 6 inches which is completely broken down. Both submaxillary glands and the bronchial glands are greatly enlarged and filled with caseous material. The posterior mediastinal glands are enlarged, the caudal node being the size of an apple, and the entire chain is caseous.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
152a	July 9 to Oct. 9	80	Dec. 14	158	No lesions	
153a	do	80	Dec. 18	162	do	
154a	do	80	Dec. 21	165	do	

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
124	Aug. 19	Milk	3	Nov. 16	89	No lesions	
125	do	do	2	do	89	do	
126	do	Cream	3	Nov. 9	82	do	
127	do	do	2	do	82	do	

Inoculation experiments—Continued.

SECOND SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
1577	Oct. 22	Cream	5	Nov. 16	25	Not tuberculosis	
1578	....do	.....do	3	Nov. 7	16	.....do	
1598	....do	Milk	5	Dec. 3	42	No lesions	
1599	....do	.....do	3	Dec. 5	44	.....do	

Cow No. 91. St. Elizabeth herd.

Age, 5 years; condition, fair; number of calves, 2; breed, grade Holstein; origin, raised.

Physical examination, September 25, 1900: Pulse, 46; respiration, 19; temperature, 100.7°. Superficial lymph glands, normal. Lungs, normal.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	101.4°	105.3°
9 a. m	101.2	106.4
12 m	100.8	105.8
3 p. m	101.2	106.1
6 p. m	102.4	105.4

Postmortem, Benning, D. C., March 8, 1901: Several calcareous areas from one-half to 1 inch in diameter are seen in principal lobes of both lungs. Posterior mediastinal glands are all enlarged, especially the caudal node, and contain calcareous foci varying from the size of a pea to a shellbark. Liver contains two nodules the size of a walnut filled with caseous tubercular material slightly calcareous in the center.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
155a	July 9 to Sept. 4	80	Sept. 4	57	Not tuberculosis	
156a	.....do	80	....do	57	.....do	
157a	July 9 to Sept. 24	80	Sept. 24	77	.....do	

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
172	Aug. 27	Milk	3	Dec. 11	106	No lesions	
173	....do	.....do	2	Sept. 25	29	Not tuberculosis	
174	....do	Cream	3	Sept. 24	28	.....do	
175	....do	.....do	2	Oct. 4	39	.....do	

SECOND SERIES.

1575	Oct. 20	Milk	5	Dec. 20	61	No lesions	
1576	....do	.....do	3	Dec. 22	63	.....do	
1581	Oct. 22	Cream	5	Dec. 5	46	Not tuberculosis	
1582	....do	.....do	3	Dec. 15	56	.....do	

Cow No. 92. St. Elizabeth herd.

Age, 8 years; condition, thin, poor feeder; number of calves, 4; breed, grade; origin, bought in Virginia six months before test.

Physical examination: Pulse, 66, and weak; respiration, 27; temperature, 103.1°. Superficial lymph glands, normal. Edema of the dewlap. Diagnosis: Traumatic pericarditis on November 22, 1900.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	102°	102°
9 a. m	101.1	104.2
12 m	100.1	105.3
3 p. m	100.8	105.4
6 p. m	101.9	104.6

Postmortem, Rosslyn, Va., December 11, 1900: Small calcareous nodule one-half inch in diameter in principal lobe of right lung; small caseous foci in cephalic lobe. Left lung shows a tuberculous mass, with completely degenerated contents, along entire posterior border of caudal lobe. The bronchial glands contain several necrotic foci. Anterior and posterior mediastinal glands affected with old tubercular deposits that appear gritty on section. Pericarditis with fibrous mass connecting reticulum to the diaphragm resulting from a foreign body, which was found.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
73a	July 9 to Oct. 9	80	Dec. 15	159	Normal	
74a	do	80	Dec. 4	148	do	
75a	do	80	Oct. 15	98	No marked lesions	

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
160	Aug. 25	Milk	3	Dec. 15	112	No lesions	
161	do	do	2	Nov. 5	72	do	
162	do	Cream	3	Dec. 4	101	do	
163	do	do	2	Sept. 1	7	Peritonitis	

SECOND SERIES.

Cow dry.

Cow No. 93. St. Elizabeth herd.

Age, 7 years; condition, good; number of calves, (?); breed, grade; origin, bought four years ago.

Physical examination, October 18, 1900: Pulse, 38; respiration, 20; temperature, 101°. Superficial lymph glands, normal. Lungs, normal.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	101.6°	103.6°
9 a. m	100	105.4
12 m	100.2	105.8
3 p. m	101.9	104.7
6 p. m	101.8	104.2

Postmortem, Rosslyn, Va., December 11, 1900: The right lung shows a few nodules in the cephalic lobe of a soft, cheesy character from one-third to 1 inch in diameter. The ventral lobe contains a tuberculous area about the size of a hen's egg, with disintegrated contents and surrounded by hyperemic tissue.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
76a	July 9 to Oct. 9	80	Oct. 21	104	No lesions	
77a	July 9 to Oct. 6	80	Oct. 6	89	Not tuberculosis	
78a	July 9 to Oct. 9	80	Dec. 1	145	No lesions	

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
165	Aug. 25	Milk	2	Sept. 15	21	Not tuberculosis	
166	....do	Cream	3	Nov. 2	69	No lesions	
167	....do	.....do	2	Nov. 4	71	.....do	

SECOND SERIES.

1579	Oct. 20	Milk	5	Nov. 18	29	No marked lesions	
1580	....do	.....do	3	Dec. 17	58	No lesions	
1592	Oct. 22	Cream	5	Nov. 26	35	Not tuberculosis	
1593	....do	.....do	3	Dec. 13	52	No lesions	

Cow No. 94. St. Elizabeth herd.

Age, 8 years; condition, fair, losing flesh; number of calves, (?); breed, grade; origin, bought six months before test.

Physical examination, December 4, 1900: Pulse, 60; respiration, 24; temperature, 102.2°. Bad cough. Superficial lymph glands, normal. Lungs: Percussion, apparently normal; auscultation—right lung, râles posterior superior third; left lung, apparently normal.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	101.9°	103.6°
9 a. m	102	105.6
12 m	101.4	106.4
3 p. m	101.6	105
6 p. m	101.8	103.1

Postmortem, Rosslyn, Va., December 21, 1900: Greater portion of principal lobes of both lungs contain tubercular areas from size of a walnut to that of a hen's egg, of caseous consistence. Bronchial lymphatic glands are slightly enlarged and contain calcareous foci of tuberculous material from one-eighth to one-third inch in diameter.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
77a	July 9 to Oct. 9	80	Oct. 27	110	Normal	
78a	do	80	Nov. 19	133	do	
79a	do	80	Dec. 12	156	do	

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
152	Aug. 24	Milk	3	Oct. 29	66	No lesions	
153	do	do	2	Oct. 28	65	Not tuberculosis	
154	do	Cream	3	Sept. 30	37	do	
155	do	do	2	Aug. 30	6	Hepatic abscess	Negative.

SECOND SERIES.

1594	Oct. 20	Milk	3	Dec. 12	53	No lesions	
1595	do	do	5	Dec. 17	58	do	
1596	do	Cream	5	Nov. 27	38	Not tuberculosis	
1597	do	do	3	Dec. 13	54	No lesions	

Cow No. 95. St. Elizabeth herd.

Age, 10 years; condition, thin and delicate; number of calves, (?); breed, common; origin, bought three years ago.

Physical examination, September 19, 1900: Pulse, 41; respiration, 24; temperature, 101.8°. Superficial lymph glands, normal. Lungs: Percussion, normal; auscultation, normal.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	101.6°	101.6°
9 a. m	102	103
12 m	101	105
3 p. m	100.7	105.9
6 p. m	102.3	105.5

Postmortem, Rosslyn, Va., December 21, 1900: The caudal lobe of right lung contains 5 caseous nodules the size of walnuts, arranged in a cluster along the dorsal margin. Anterior and posterior mediastinal glands show a few miliary foci undergoing necrotic changes. Right retropharyngeal gland is enlarged and has completely undergone a cheesy degeneration.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
80a	July 9 to Oct. 7.....	80	Oct. 7	90	Not tuberculosis	
81a	July 9 to Sept. 13....	80	Sept. 13	66	Pneumonia	
82a	July 9 to Oct. 9.....	80	Oct. 20	103	Not tuberculosis	

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
156	Aug. 24	Milk.....	3	Oct. 15	52	Normal.....	
157	....do...	.....do.....	2	Oct. 26	63	.....do.....	
158	....do...	Cream.....	3	Nov. 3	71	.....do.....	
159	....do...	.....do.....	2	Sept. 23	30	Not tuberculosis.....	

SECOND SERIES.

1457	Oct. 20	Milk.....	5	Dec. 15	56	No lesions.....	
1590	....do...	.....do.....	5	Dec. 18	59	.....do.....	
1591	....do...	.....do.....	3	Dec. 26	67	.....do.....	
1600	Oct. 22	Cream.....	3	Jan. 24	94	.....do.....	
1601	....do...	.....do.....	5	Jan. 25	95	.....do.....	

Cow No. 96. St. Elizabeth herd.

Age, 6 years; condition, unthrifty; number of calves, 3; breed, Holstein; origin, raised.

Physical examination, October 25, 1900: Pulse, 42; respiration, 23; temperature, 102.6°. Superficial lymph glands, normal. Lungs, normal.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	102.1°	102.8°
9 a. m	101.8	105
12 m	101.6	106.1
3 p. m	102	106.6
6 p. m	102.8	105.4

Postmortem, Fowlers, D. C., April 12, 1901: Four caseous foci in principal lobe of left lung from the size of a walnut to a hen's egg. One area in posterior part of right principal lobe the size of a walnut containing gritty particles. One small focus of a cheesy nature one-fourth inch in diameter in right posterior pharyngeal gland.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
83a	July 9 to Oct. 9	80	Dec. 12	156	Normal	
84a	do	80	Nov. 9	123	do	
85a	do	80	Nov. 10	124	do	

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
144	Aug. 23	Milk	3	Nov. 22	91	Normal	
145	do	do	2	Oct. 12	50	do	
146	do	Cream	3	Sept. 29	37	Not tuberculosis	
147	do	do	2	Sept. 23	31	do	

SECOND SERIES.

1603	Oct. 22	Milk	3	Dec. 9	48	Normal	
1604	do	Cream	5	Nov. 25	34	Not tuberculosis	
1605	do	do	3	Nov. 3	12	Hepatic abscess	Negative.

Cow No. 97. St. Elizabeth herd.

Age, 6 years; condition, good; number of calves, 3; breed, Holstein; origin, raised. Physical examination, October 10, 1900: Pulse, 38; respiration, 21; temperature, 101.8°. Superficial lymph glands, normal. Lungs, normal.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	102.1°	107°
9 a. m	101.8	107.5
12 m	101.8	106
3 p. m	102	107.2
6 p. m	102.2	104

Postmortem, Fowlers, D. C., April 12, 1901: Several caseous nodules, three-fourths to 2½ inches in diameter in principal lobes of both lungs having thick, strong encapsulating walls. Right bronchial gland is greatly enlarged, and contains a disintegrated mass of tuberculous material.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
86a	July 9 to Aug. 12	80	Aug. 12	34	No marked lesions	
87a	July 9 to Oct. 9	80	Oct. 19	102	Not tuberculosis	
88a	July 9 to Aug. 6	80	Aug. 6	28	Ruptured stomach	

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
148	Aug. 23	Milk	3	Dec. 17	116	Normal	
149	....do...	.....do	2	Aug. 29	6	Abscess at point of inoculation.	
150	....do...	Cream	3	Sept. 6	14	No lesions	
151	....do...	.....do	2	Sept. 27	35	Not tuberculosis	

SECOND SERIES.

1607	Oct. 22	Milk	3	Dec. 20	59	Pneumonia	Negative.
1608	....do...	Cream	5	Oct. 24	2	Septicemia	
1609	....do...	.....do	3	Jan. 9	79	No lesions	

Cow No. 98. St. Elizabeth herd.

Age, 7 years; condition, good; number of calves, 4; breed, Holstein; origin, raised.

Physical examination, October 25, 1900: Pulse, 38; respiration, 20; temperature, 102.1°. Superficial lymph glands, normal. Lungs: Percussion, apparently normal; auscultation, right lung, apparently normal; left lung, apparently normal.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	101.9°	103°
9 a. m	101.8	104.6
12 m	101.6	105.3
3 p. m	101.8	105.6
6 p. m	102.2	102.9

Postmortem, Fowlers, D. C., April 12, 1901: The lungs are filled with tuberculous nodules that have become confluent in both caudal and the left cephalic lobes. In the left caudal lobe a large abscess cavity is seen that involves a large bronchus. The mucous membrane of the trachea contains two or three tuberculous ulcers and nodules from the size of a dime to that of a half dollar. The anterior and posterior mediastinal glands are greatly swollen and show caseous degeneration. The tonsils are also enlarged and contain caseous material. One nodule under the mucous membrane on the posterior superior surface of the tongue was found tuberculous on microscopic examination.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
89a	July 9 to Oct. 9	80	Nov. 13	127	Not tuberculosis	
90a	.....do	80	Nov. 19	133	Normal	
91a	.....do	80	....do...	133	.....do	

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
168	Aug. 27	Milk	3	Sept. 21	25	Not tuberculosis	
169	....do	.....do	2	Nov. 6	71	No lesions	
170	....do	Cream	3	Sept. 26	30	Not tuberculosis	
171	....do	.....do	2	Sept. 15	19	Hepatic abscess	Negative.
SECOND SERIES.							
1611	Oct. 22	Milk	3	Dec. 15	54	No lesions	
1681	....do	.....do	5	Nov. 26	35	Tuberculosis	Positive.
1682	....do	Cream	3	Nov. 24	33	.....do	Do.

Cow No. 99. St. Elizabeth herd.

Age, 7 years; condition, good; number of calves, 4; breed, Holstein; origin, raised.

Physical examination, October 10, 1900: Pulse, 52; respiration, 21; temperature, 101.8°. Superficial lymph glands, normal. Lungs, normal.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	101.8°	104°
9 a. m	102	105
12 m	101.4	103.4
3 p. m	101.8	103.4
6 p. m	102.5	101.4

Postmortem, Rosslyn, Va., February 1, 1901: Posterior portion of principal lobe of right lung contains one large tuberculous region 5 inches long by 3 inches wide, which protrudes as if separated by a retaining band from the normal lung tissue. The contents are completely degenerated and semifluid in consistence. The trachea shows four circumscribed abscesses the size of shellbarks along its external anterior border following the course of the lymphatic vessels, and a suppurating ulcer on the mucous membrane. Both retropharyngeal glands are enlarged, the left containing three necrotic centers, while the right is completely degenerated and gritty on section. The right bronchial gland is the size of a duck's egg and likewise calcified. Several retention cysts in the udder.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
92a	July 9 to Oct. 9	80	Nov. 2	116	Not tuberculosis	
93a	.....do	80	Nov. 7	121	.....do	
94a	.....do	80	Dec. 21	165	Normal	

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
132	Aug. 21	Milk	3	Nov. 1	72	Normal	
133	....do	.....do	2	Sept. 28	38	Pneumonia	
134	....do	Cream	3	Oct. 16	56	Normal	
135	....do	.....do	2	Oct. 22	62	.....do	

SECOND SERIES.

1643	Oct. 24	Milk	5	Dec. 20	57	Normal	
1644	....do	.....do	3	Jan. 10	78	.....do	
1645	....do	Cream	5	Jan. 17	85	.....do	
1646	....do	.....do	3	Nov. 19	26	Not tuberculosis	

Cow No. 100. St. Elizabeth herd.

Age, 7 years; condition, good; number of calves, (?); breed, grade; origin, bought three years ago.

Physical examination, September 11, 1900: Pulse, 38; respiration, 20; temperature, 101°. Superficial lymph glands, normal. Lungs, normal.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	101.6°	101.7°
9 a. m	101.3	102.2
12 m	101.2	104.1
3 p. m	101.2	103.9
6 p. m	101.7	102.6

Postmortem, Fowlers, D. C., April 12, 1901: The principal lobe of left lung contains a caseous tuberculous focus three-fourth inch in diameter, surrounded by hyperplastic tissue. Both right and left bronchial glands are enlarged, and show three or four tubercular foci about one-fourth inch in diameter, undergoing calcification.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
95a	July 9 to Oct. 9	80	Dec. 17	161	No lesions	
96a	.....do	80	Dec. 15	159	.....do	
97a	.....do	80	Dec. 26	170	.....do	

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
136	Aug. 21	Milk	3	Sept. 16	26	Not tuberculosis	
137	....do	.....do	2	Nov. 20	91	No lesions	
138	....do	Cream	3	Sept. 4	14	Not tuberculosis	
140	....do	.....do	2	Nov. 24	96	No lesions	

SECOND SERIES.

Cow dry.

Cow No. 102. St. Elizabeth herd.

Age, 7 years; condition, poor; number of calves, 3; breed, Holstein; origin, raised.

Physical examination, September 30, 1900: Pulse, 64; respiration, 27; temperature, 101.8°. Superficial lymph glands, normal. Lungs: Percussion, right lung, areas of dullness, left lung, slight dullness over superior portion posterior lobe; auscultation, right lung, absence of breath sounds posterior inferior part, left lung, small sibilant râles surrounding areas of silence.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	100.8°	103.7°
9 a. m	101.1	105.4
12 m	101.3	105.1
3 p. m	102.4	104.6
6 p. m	102.9	104.7

Postmortem, Rosslyn, Va., December 21, 1900: The parenchyma of both lungs is permeated with numerous isolated and confluent tubercular areas varying from the size of a hemp seed to a large lemon, with caseous contents. All the nodes of the mediastinal chain are enlarged and contain caseous and calcareous material. Posterior part of pleura, both sides of diaphragm, and anterior part of peritoneum are studded with fresh tubercular excrescences. Liver is covered with tubercular nodules extending into parenchyma. Majority of mesenteric glands show tubercular foci from one-eighth to one-half inch in diameter, some caseous, others calcareous.

Microscopic examination of centrifugal sediment of milk, positive; of cream positive.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
99a	July 9 to Aug. 30	120	Aug. 30	52	Tuberculosis	Positive.
100a	July 9 to Oct. 9	120	Oct. 17	100	.....do	Do.

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
100	Aug. 17	Cream	3	Aug. 21	4	Peritonitis	
101	....do	.....do	2	Dec. 27	132	No lesions	
102	....do	Milk	3	Sept. 23	37	Tuberculosis	Positive.
103	....do	.....do	2	Aug. 21	4	Peritonitis	

SECOND SERIES.

1647	Oct. 24	Milk	5	Nov. 23	30	Tuberculosis	Positive.
1648	....do	.....do	3	Nov. 22	29	.....do	Do.
1649	....do	Cream	5	Dec. 14	51	.....do	Do.
1650	....do	.....do	3	Dec. 18	55	.....do	Do.

Cow No. 103. St. Elizabeth herd.

Age, 5 years; condition, fair; number of calves, 2; breed, Holstein; origin, raised. Physical examination, September 11, 1900: Pulse, 50; respiration, 28; temperature, 101.9°. Glands: Submaxillaries, enlarged; supramammary, normal. Lungs, normal.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	101°	102.6°
9 a. m	101.1	106.2
12 m	101.6	107
3 p. m	101.4	106.2
6 p. m	102.8	105.6

Postmortem, Rosslyn, Va., February 1, 1901: The lungs show six or seven tuberculous areas, from the size of a pea to a pigeon's egg, scattered throughout the parenchyma. The posterior mediastinal glands contain four calcareous foci the size of hazelnuts well encapsulated. Both bronchial and anterior mediastinal glands show degenerated foci from one-eighth to one-half inch in diameter. Both submaxillary glands completely degenerated and the size of walnuts.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
101a	July 9 to Oct. 9	120	Nov. 3	117	Normal	
102a	.....do	120	Dec. 11	155	.....do	

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
104	Aug. 17	Cream	3	Sept. 15	29	Chronic peritonitis	
105	....do	.....do	2	Nov. 19	94	Normal	
106	....do	Milk	3	Oct. 1	45	.....do	

SECOND SERIES.

1651	Oct. 24	Milk	5	Dec. 12	49	No lesions	
1652	....do	.....do	3	Dec. 17	54	.....do	
1653	....do	Cream	5	Jan. 11	79	.....do	
1654	....do	.....do	3	Jan. 23	91	.....do	

Cow No. 104. St. Elizabeth herd.

Age, 4 years; condition, good; number of calves, 2; breed, Holstein; origin, raised.

Physical examination, October 25, 1900: Pulse, 48; respiration, 24; temperature, 102.6°; M. M., normal; udder, palpation normal. Glands: Submaxillary, normal; supramammary, normal. Lungs: Percussion, apparently normal; auscultation, apparently normal.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	101.4°	104.8°
9 a. m	101.8	106.9
12 m	101	107.2
3 p. m	101.4	106.8
6 p. m	102.3	103

Postmortem, Rosslyn, Va., December 11, 1900: Apex of right lung contains a yellow caseous nodule the size of a walnut, well encapsulated. Left caudal lobe has four tuberculous areas from the size of a shellbark to an egg, which contain calcareous material. Great many grape-like clusters are sprinkled over entire left pleura and anterior surface of diaphragm. Right and left bronchial and anterior and posterior mediastinal glands are enlarged and degenerated with caseous contents. Left prepectoral gland of normal size, but shows three small necrotic foci. Left posterior pharyngeal gland slightly enlarged and undergoing cheesy degeneration. Liver shows numerous angiomata, otherwise normal.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
103a	July 9 to Sept. 12	60	Sept. 12	65	Tuberculosis	Positive.
104a	July 9 to Oct. 9	60	Nov. 26	140	Normal	
105a	.....do	60	Nov. 18	132	.....do	
106a	.....do	60	Oct. 26	109	Tuberculosis	Do.

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
124	Aug. 21	Milk	3	Sept. 24	34	Tuberculosis	Positive.
125	....do	.....do	2	Sept. 4	14	Pneumonia	Negative.
126	....do	Cream	3	Nov. 28	99	No lesions	
127	....do	.....do	2	Nov. 27	98	.....do	

SECOND SERIES.

1655	Oct. 24	Milk	5	Dec. 20	57	No lesions	
1656	....do	.....do	3	Dec. 18	55	.....do	
1657	....do	Cream	5	Jan. 4	72	.....do	
1650	....do	.....do	3	Dec. 7	44	.....do	

Cow No. 105. St. Elizabeth herd.

Age, 9 years; condition, poor; number of calves, (?); breed, Holstein; origin, bought four years ago.

Physical examination, September 11, 1900: Pulse, 50; respiration, 23; temperature, 101°. Superficial lymph glands, normal. Lungs, apparently normal.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	101.2°	104.2°
9 a. m	100.8	105.3
12 m	101.4	105.3
3 p. m	102.3	104.5
6 p. m	102.9	105

Postmortem, Rosslyn, Va., December 21, 1900: Parenchyma of both lungs studded with tuberculous nodules varying in size from one-half to 1½ inches in diameter. Costal pleura covered with isolated and confluent grape-like masses of tuberculous nature. These new formations are about one-half inch thick on the diaphragm, and seem of recent origin. The prepectoral glands show three caseous foci, one-fourth to three-eighths inch in diameter. Anterior and posterior mediastinal glands contain several hempseed-like areas that are calcareous.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
107a	July 9 to Oct. 9	80	Dec. 18	162	No lesions	
108a	.....do	80	Oct. 12	95	No marked lesions	
109a	.....do	80	Oct. 31	114	No lesions	

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
128	Aug. 21	Milk	3	Aug. 26	5	Peritonitis	
129	....do	.....do	2	Oct. 3	43	Normal	
130	....do	Cream	3	Aug. 25	4	Peritonitis	
131	....do	.....do	2	Oct. 25	65	No lesions	

SECOND SERIES.

1659	Oct. 24	Milk	5	Dec. 24	61	Hepatitis	Negative.
1660	....do	.....do	3	Jan. 12	80	Normal	
1661	....do	Cream	5	....do	80	.....do	
1662	....do	.....do	3	Dec. 18	55	.....do	

Cow No. 106. St. Elizabeth herd.

Age, 6 years; condition, good; number of calves, 3; breed, Jersey; origin, raised. Physical examination, December 4, 1900: Pulse, 46; respiration, 18; temperature, 102.2°. Hard fibrous tumor of actinomycosis on left lower jaw. Superficial lymph glands, normal. Lungs: Percussion, right lung, posterior third dull, left lung, apparently normal; auscultation, right lung, many mucous râles and loss of sound, left lung, apparently normal.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	101.3°	104.2°
9 a. m	101.8	106.2
12 m	100.8	106.3
3 p. m	101.5	106.3
6 p. m	101.2	104.5

Postmortem, Rosslyn, Va., December 17, 1900: Actinomycotic tumor the size of one's fist on left side of inferior maxilla involving the bone. No fistula could be found. Right retropharyngeal gland enlarged and contains caseous tubercular material. Posterior mediastinal and bronchial glands contain several tubercular foci. Posterior part of caudal lobe of right lung transformed into a tubercular mass. Two caseous foci in the ventral lobe the size of walnuts. Main lobe of left lung contains three or four degenerated areas from one-half to 1 inch in diameter.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
110a	July 9 to Sept 8	80	Sept. 8	61	Not tuberculosis	
111a	July 9 to Aug. 31	80	Aug. 31	53	.....do	
112a	July 9 to Oct. 9	80	Nov. 28	142	No lesions	

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
116	Aug. 18	Milk	3	Dec. 15	119	No lesions	
117	....do	.....do	2	Sept. 29	42	Not tubercular	
118	....do	Cream	3	Oct. 1	44	.....do	
119	....do	.....do	2	Oct. 5	48	.....do	

SECOND SERIES.

1663	Oct. 24	Milk	5	Nov. 23	30	No lesions	
1664	....do	.....do	3	Dec. 19	55	.....do	
1722	Oct. 25	Cream	5	Dec. 22	58	.....do	
1723	....do	.....do	3	Dec. 18	54	.....do	

Cow No. 108. St. Elizabeth herd.

Age, 8 years; condition, good; number of calves, 4; breed, Holstein; origin, raised.

Physical examination, September 11, 1900: Pulse, 56; respiration, 23; temperature, 101.3°. Glands: Left submaxillary, size of walnut; supramammary, normal. Lungs, normal.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	101.6°	102.2°
9 a. m	100.9	103.1
12 m	102	105.2
3 p. m	101.2	105.9
6 p. m	102.4	104.6

Postmortem, Rosslyn, Va., December 17, 1900: On the dorsal margin of the left principal lobe is an irregular cluster of tubercular nodules in varying stages of degeneration, measuring from 2 to 3 inches in diameter. The main lobe of the right lung contains a nodule the size of a silver dollar that contains a semicalcareous material. The right bronchial gland shows five similar foci, while the entire mediastinal chain of lymph glands present numerous small firm tubercles, some showing caseation, others calcification.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
116a	July 9 to Oct. 9	80	Nov. 30	144	No lesions	
117a	.....do	80	Dec. 4	148	.....do	
118a	.....do	80	Jan. 9	184	.....do	

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
120	Aug. 18	Milk	3	Sept. 6	19	Pneumonia	
121	....do	.....do	2	Nov. 5	79	No lesions	
122	....do	Cream	3	Nov. 23	97	.....do	

SECOND SERIES.

1667	Oct. 25	Milk	5	Nov. 23	29	Hepatitis	Negative.
1668	....do	.....do	3	Jan. 6	78	No lesions	
1669	....do	Cream	5	Jan. 3	70	.....do	
1670	....do	.....do	3	Oct. 27	2	Septicemia	

Cow No. 109. St. Elizabeth herd.

Age, 7 years; condition, rather poor; number of calves, 4; breed, grade Holstein; origin, raised.

Physical examination, October 18, 1900: Pulse, 38; respiration, 22; temperature, 101.9°. Superficial lymph glands, normal. Lungs, normal.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	100.9°	101.8°
9 a. m	101	105
12 m	101.1	105.7
3 p. m	101.2	105.8
6 p. m	102.1	104.5

Postmortem, Fowlers, D. C., May 15, 1901: The parietal and pulmonary pleura are studded with numerous tuberculous neoplasms more or less confluent, forming what is commonly known as pearl disease. The ventral lobe of right lung contains a caseous area 2 inches in diameter opening into a bronchial tube. The mucous membrane of the trachea about 5 inches from its bifurcation shows a tuberculous ulcer. Three inches anterior to this are seen two other ulcers that have become confluent.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
128a	July 9 to Oct. 9	80	Nov. 12	126	Normal	
129a	.....do	80	Nov. 21	135	.....do	
130a	.....do	80	Nov. 10	124	.....do	

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection.	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
108	Aug. 14	Cream	3	Nov. 27	105	Normal	
109	....do	.....do	2	Nov. 1	79	.....do	
110	....do	Milk	3	Sept. 5	22	Not tuberculosis	
111	....do	.....do	2	Oct. 15	62	Normal	

SECOND SERIES.

1671	Oct. 25	Milk	5	Jan. 3	70	Normal	
1672	....do	.....do	3	Jan. 5	72	.....do	
1673	....do	Cream	5	Jan. 27	93	.....do	
1674	....do	.....do	3	....do	93	.....do	

Cow No. 112. St. Elizabeth Herd.

Age, 6 years; condition, good; number of calves, 3; breed, Holstein; origin, raised.

Physical examination, October 18, 1900: Pulse, 48; respiration, 26; temperature, 101.3°. Superficial lymph glands, normal. Lungs, normal.

Tuberculin test.

Hour.	May 2, 1900. Before injection.	May 3, 1900. After injection.
6 a. m	100.6°	102°
9 a. m	101.2	103.1
12 m	101	102.8
3 p. m	101.5	105.6
6 p. m	102	104.5

Postmortem, Fowlers, D. C., May 15, 1901: Few small caseous foci about one-fourth inch in diameter in principal lobe of right lung. Right bronchial gland slightly enlarged and contains two or three centers of caseous material. Posterior mediastinal glands are slightly enlarged with several caseated foci the size of a pea.

Microscopic examination of centrifugal sediment of milk, negative; of cream, negative.

Feeding experiments.

Guinea pig No.	Duration of experiment.	Amount fed daily.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
		c. c.				
158a	July 9 to Oct. 9	80	Nov. 15	129	No lesions	
159a	.....do	80	Dec. 27	171	Not tuberculosis	
160a	.....do	80	Oct. 27	110	.....do	

Inoculation experiments.

FIRST SERIES.

Guinea pig No.	Date of injection	Material.	Dose injected.	Date when killed or died.	Number of days alive.	Postmortem diagnosis.	Microscopic examination of lesions.
			c. c.				
112	Aug. 17	Cream	3	Sept. 1	15	Not tuberculosis	
113	do	do	2	Sept. 23	37	do	
114	do	Milk	3	Sept. 21	35	Rupture of cecum	
115	do	do	2	Nov. 14	89	No lesions	

SECOND SERIES.

1675	Oct. 25	Milk	5	Nov. 23	29	Not tuberculosis	
1676	do	do	3	Nov. 30	36	do	
1677	do	Cream	5	Nov. 16	22	Hepatic abscess	Negative.
1678	do	do	3	Dec. 15	51	No lesions	

In order to show more conveniently and also more vividly the positive results obtained from those cows that were found to be excreting tubercle bacilli in the milk, the following synthetical table is appended:

Summary of cows secreting tuberculous milk, with the results of microscopic examination.

Number of cow.	Lesions of guinea pig fed.	Centrifugalized milk.	Centrifugalized cream.	Lesions of guinea pig injected, first series.	Lesions of guinea pig injected, second series.
4	Positive	Negative	Negative	Positive	Negative.
10	Negative	Positive	do	Negative	Do.
12	do	Negative	do	do	Positive.
15	Positive	do	do	Positive	Negative.
64	Negative	do	do	do	Positive.
65	Positive	Positive	Positive	Negative	Do.
71	do	Negative	Negative	do	Do.
73	do	do	do	do	Do.
74	do	do	do	do	No inoculation.
77	do	Positive	do	Positive	Do.
98	Negative	Negative	do	Negative	Positive.
102	Positive	Positive	Positive	Positive	Do.
104	do	Negative	Negative	do	Negative.

The above synopsis of positive results obtained from the feeding and inoculation experiments, as well as from the microscopic examination of the centrifugalized sediment of milk and cream, indicates that one or more of the guinea pigs fed with milk from 9 different cows have succumbed with typical tuberculosis; that is, the milk of 16.07 per cent of the 56 reacting cows has been found to be pathogenic to guinea pigs when fed to them. Of the experimental animals inoculated intraabdominally in the first series, at least 1 guinea pig has died of tuberculosis in each of 6 different instances, showing that the milk of 10.9 per cent of the 55 reacting cows in this experiment has proven fatal to guinea pigs in the first inoculation experiment. In the second series of intraabdominal injections the milk from 7 individual cows out of 45 examined, or 15.5 per cent, was demonstrated to possess virulent tubercle bacilli. By uniting these inoculation results it will be observed that 11 out of 55 cows, or 20 per cent, secreted milk which

transmitted tuberculosis to one or more experimental animals when injected into the peritoneal cavity.

Owing to the greater percentage of positive results obtained from the second inoculation experiment, conducted more than two months after the first intraabdominal test, it appears probable, as would be expected, that the virulence of milk increases with the advancement of the disease in the cow. The lack of uniformity of results obtained in many of the cows might be explained from our knowledge that tubercle bacilli are not excreted by the normal udder with any degree of constancy. For this reason the continuous feeding experiment, covering a period of three months, seems to have more practical value in demonstrating the transmission of tuberculosis than the inoculation test, where the only possibility of affirmative results must depend on the contingency of the accidental excretion of the bacilli on one particular day.

The combined results of the ingestion and inoculation experiments show that the milk of 12 out of 56 reacting cows, or 21.4 per cent, has at one time or another since the beginning of the experiment contained virulent tubercle bacilli.

Cover-glass preparations of the centrifugalized sediment of milk from 4 out of 55 cows, or 7.2 per cent, revealed the presence of the tubercle bacillus, and in 2 of these cases the centrifugalized cream was also found to possess this organism. In one case (cow No. 10) tubercle bacilli were demonstrated only by microscopic examination of the centrifugalized milk sediment. The number observed was very scarce, 3 in one slide and but 1 in another, while the remaining 9 cover glasses were apparently free from this bacillus. It appears singular that positive results were not obtained by the intraabdominal injection of this sediment from which the cover glasses showing the tubercle bacilli were made. Wyssokowitsch in his experiments regarding the quantity of bacilli requisite for the production of tuberculosis by injection into the peritoneal cavity, found that it required at least 30 bacilli for the transmission of the disease. Granting this conclusion, it is evident that the milk injected either did not contain a sufficient number of bacilli to cause the disease or that the bacilli were less vigorous or the guinea pigs more resistant than in the other experiments. It is also of interest to know that of the guinea pigs that succumbed to tuberculosis as a result of intraabdominal inoculation, 7 were injected with a mixture of milk and cream, 5 with centrifugalized cream alone, and the remaining 8 with the milk sediment.

With one cow (No. 102) positive results were obtained in all the tests—that is, by ingestion, by inoculation, and by microscopic examination of the sediment of the milk and cream—although but 7 of the 10 experimental animals fed and inoculated with the milk of this cow became tubercular. At the beginning of the investigation the cow

was in apparently good condition, but late in September stethoscopic râles could occasionally be heard which gradually became more perceptible. She became unthrifty, fell off in flesh, and gave strong clinical evidence of tuberculosis. Early in September mucous râles were observed by auscultation of the lungs of cow No. 65. A similar unthriftiness and loss of flesh were observed as noted in the previous animal and before the experiment was concluded she was a mere skeleton. With these exceptions, the cows from which positive results were obtained appeared in good condition without manifesting any clinical symptoms of tuberculosis while the experiment was being conducted. During this period a physical examination of all the cows was made on frequent occasions and the first evidence of clinical symptoms has been noted in the physical examination described in the preceding tables (pp. 26 to 78). In comparing the virulence of the milk with the extent of the postmortem lesions found in the cows, the latter may be arranged in three classes. The first group would include those animals that have shown physical evidences of tuberculosis during the experiment and would embrace cows Nos. 65 and 102. The second group comprises the cattle in which the postmortem lesions were extensive, and generalized, but in which no apparent physical symptoms could be observed during the experiment, and includes cows Nos. 10, 12, 15, 64, 71, 73, 74, and 77. In the third class the lesions were found to be extensive but confined to the respiratory tract and contains cows Nos. 4, 98, and 104.

It is with the last two classes of cows which are in apparently good condition, but which occasionally excrete tubercle bacilli, that the great danger remains hidden and which demands that all milk from tubercular cows should be sterilized before using. The lesions of tuberculosis were in the majority of cases of such a nature that a short prolongment of their lives might probably have placed them in the first group.

Moreover, from a review of the postmortem notes it will be seen that some cows which gave negative results in the milk experiments were as markedly diseased as some that gave positive results. This is of interest in showing the great uncertainty attached to the intelligent selection of cows producing tuberculous milk by any method other than the unfeasible one of microscopic examination, or what is far better, though equally impracticable, the animal inoculations of the milk from each individual cow. And it likewise indicates the danger involved in drawing conclusions from experiments with a few cattle such as would include these negative cases to the exclusion of others no more diseased but nevertheless secreting infectious milk.

It should also be remembered, in comparing the disease found on postmortem examination with the virulence of the milk secreted, that the cows were permitted to live from two to thirteen months following the investigation, and it is but logical to presume that, on the whole,

the disease was less marked at the time of the experiment than on the date of the postmortem.

Specimens of the mammary glands from all the above-mentioned cows were brought to the laboratory and histological examination made, but without finding any indication of tuberculosis. Special attention was given to the udder of cow No. 102, and numerous serial sections were examined with entirely negative results.

Owing to the uncertainty of diagnosing the extent of tuberculosis in a reacting animal, the impossibility of saying at what moment a latent, incipient, or localized infection may develop into a generalized or extensive case with probable involvement of the mammary gland, and to the further fact that it is difficult to recognize the beginning of tuberculosis in the udder, it behooves one to look at least with suspicion upon the milk of all tuberculous cows. It is a strongly suggestive fact that many cases of tuberculosis of the supramammary lymph glands in which there may be no evident udder lesion can hardly be explained without assuming that the bacilli had entered from the lymphatics of the mammæ. Furthermore the great prevalence and constant increase of tuberculosis among hogs fed upon the by-products from dairies and creameries point forcibly to the milk as the means by which the disease is transmitted and disseminated. It may also be worth mentioning in this connection that Bang considers it possible for milk to retain its normal appearance for at least a month after the udder shows tuberculous involvement.

The result of this investigation demonstrated fully the necessity for thorough sterilization of the milk from reacting cows before it was consumed as food, and precautions of this nature were at once observed by the asylum authorities. The danger to the consumer of this raw milk seems palpable, although it is not assumed to be in direct proportion to the positive results obtained in such susceptible animals as guinea pigs.

SUPPRESSION AND ERADICATION.

In dealing with the question of the eradication of tuberculosis from this herd in order to obtain a permanent supply of hygienic milk, several courses were possible of adoption, and they were presented to the superintendent of the asylum, as follows:

The quickest and most radical method would be to destroy all of the affected animals and to substitute fresh tuberculin-tested cows. This would, however, involve a great and immediate outlay of money and would necessitate a thorough disinfection and partial reconstruction of the present premises. It would also require constant vigilance and semiannual tuberculin tests in order to discover incipient cases of tuberculosis and to eliminate them before they become dangerous to the health of the remaining animals.

Another method would be to dispose of those animals whose milk had been found to contain virulent tubercle bacilli and to retain the remainder of the reacting cows for breeding and dairy purposes. All calves born from these cows should then be

tested with tuberculin shortly after birth, and, when found free from the disease, should be removed to the stable in which the nonreacting cows are kept and be brought up on sterilized milk or on milk from nonreacting cows. In this case it would only be necessary to substitute the 13 above-mentioned cows that were secreting tuberculous milk with tuberculin-tested animals. The sterilization of the milk from the reacting cows should, however, be continued, and constant veterinary supervision would be required for the purpose of eliminating cases which on physical examination are judged to have passed from the incipient into a dangerous stage.

Finally, the present condition might be allowed to continue and only such cows be disposed of which, in the opinion of the farm superintendent, did not pay for their keep. All newly born calves should be dealt with in the same manner as above described. This method of eradicating tuberculosis, known as the Danish method, has been found to be practical, but requires, under the best circumstances, four or five years.

In either of the two latter cases the greatest drawback is the necessity for keeping two distinct herds with separate attendants, implements, and dairy utensils. The premises at the asylum are, however, well adapted for the carrying out of either of these plans, there being two separate stables, each with an adjoining lot.

A fourth plan would be to turn the entire dairy department of the asylum over to a private party or syndicate, the asylum agreeing to pay a certain price per gallon for the milk, and the lessees to provide tuberculin-tested cows and to keep them under such sanitary conditions as the superintendent of the asylum would deem necessary in order to obtain a good quality of pure milk.

After due consideration of these various propositions by the asylum authorities, it was decided to adopt the first method of eradicating the disease. With this in view the animals in the infected barn were gradually slaughtered as they became dry until the herd had been reduced sufficiently to occupy but one-half of the stable. This portion of the stable was then boarded up tightly while the other half was being torn out and reconstructed. The entire floor, as well as the supporting beams, were replaced; new windows were located along the sides, and every painstaking effort was directed toward the production of a strictly hygienic stable. Individual mangers and stanchions were constructed and the entire woodwork, with the exception of the floor, was given two coats of paint. This thoroughness in cleaning out the possible danger of reinfection was likewise adopted in renovating the other half of the stable after the last tuberculous animal had been slaughtered.

As already stated, it was decided to concentrate the expense connected with the eradication of such an extensive infection in the herd and dispose of all the reacting cows. In all cases the cows were sold to local butchers, subject to the postmortem examination of the District health officer. Only the carcasses of those animals in which the disease was localized or in an incipient stage were passed as fit for food. Brief notes regarding the history and postmortem examination of the cows reacting to the first tuberculin test, but not in the milk experiment, follow:

Cow No. 21.—Grade, Holstein; 5 years old; raised; in good condition; weight, 910 pounds.

Postmortem at Fowlers, D. C., April 8, 1901: Three small nodules of caseous material in each posterior pharyngeal gland. One small focus in right bronchial gland. Carcass passed.

Cow No. 22.—Red; common stock; 7 years old; bought two years ago; apparently in normal condition; weight, 840 pounds.

Postmortem at Fowlers, D. C., April 4, 1901: One small focus in right retropharyngeal gland. One nodule, size of a pigeon's egg, in right cephalic lobe and four foci, containing cheesy deposit, in ventral lobe of left lung. Carcass passed.

Cow No. 23.—Black Holstein heifer; 3 years old; raised; in fair condition; weight, 610 pounds.

Postmortem at Rosslyn, Va., March 8, 1901: Left lung contains a number of small foci in posterior portion of ventral lobe. Posterior mediastinal gland considerably enlarged and contains three or four encysted foci that have undergone calcareous degeneration. Carcass passed.

Cow No. 24.—Dark brindle; 9 years old; purchased three years ago; in ordinary condition; weight, 970 pounds.

Postmortem at Rosslyn, Va., February 1, 1901: Right bronchial lymph gland greatly enlarged and degenerated. Entire posterior mediastinal chain of glands contains nodules. Right lung shows caseous areas throughout entire parenchyma. Left lung contains four or five foci, principally in ventral lobe. Liver has three tuberculous foci about the size of a hazelnut in the parenchyma and several neoplasms adhering to the capsule. One mesenteric gland contains two pea-sized foci. The right anterior quarter of the udder on cross section appears indurated and knotty with miliary foci and yellowish lines of tuberculous material following the course of the lacteals. The mucous membrane of the milk cistern contains several tubercles, but the supramammary lymph glands are apparently not involved. A microscopic examination of cover-glass preparations made from the udder shows tubercle bacilli. Carcass condemned.

Cow No. 25.—Holstein grade; 7 years old; raised; has been a good feeder, but going back recently; weight, 960 pounds.

Postmortem at Rosslyn, Va., February 1, 1901: Right lung has a focus in its apex the size of a pea. Right bronchial gland enlarged and caseous. Posterior mediastinal gland contains several miliary foci of caseous material. Liver shows three large caseous abscesses, size of a hen's egg and containing putrid pus. Spleen is adherent by dense fibrous tissue to the paunch and contains an abscess with foul-smelling contents. Large fibrous mass attached to diaphragm and paunch is also seen in which a foreign body is embedded. Carcass condemned.

Cow No. 26.—Holstein heifer; 2 years old; raised; in good condition; weight, 690 pounds.

Postmortem at Rosslyn, Va., February 1, 1901: Six or seven mesenteric glands enlarged and contain a number of foci in various stages of degeneration. Mucous membrane of the intestinal tract normal. Liver normal. Carcass passed.

Cow No. 27.—Red heifer; 3 years old; raised; no evidence of tuberculosis on physical examination, but animal has not been doing well; weight, 615 pounds.

Postmortem at Rosslyn, Va., February 1, 1901: Posterior mediastinal glands greatly enlarged and filled with calcareous material. Right bronchial gland has several calcareous foci. Numerous miliary tubercles in apex of right lung. Carcass condemned.

Cow No. 28.—Holstein grade; 5 years old; raised; in good flesh and thrifty; weight, 870 pounds.

Postmortem at Rosslyn, Va., February 1, 1901: Several small foci about size of hazelnut in ventral lobe of left lung. Small tubercular nodule in posterior mediastinal gland. Carcass passed.

Cow No. 29.—Red buffalo; common stock; 7 years old; bought three years ago; poor feeder and falling off in flesh; weight, 735 pounds.

Postmortem at Rosslyn, Va., February 1, 1901: Large tubercular mass in caudal lobe of right lung which appears adherent to the diaphragm. Two small nodules are observed in the ventral lobe of left lung. Right bronchial gland enlarged and completely degenerated. Liver is studded with various-sized neoplasms. Several mesenteric glands enlarged and contain tuberculous areas. Carcass condemned.

Cow No. 30.—Red buffalo; common stock; 7 years old; bought three years ago; poor feeder and falling off in flesh; weight, 690 pounds.

Postmortem at Rosslyn, Va., February 1, 1901: Both anterior and posterior mediastinal glands enlarged and contain cheesy material. The right ventral lobe contains a large abscess filled with tuberculous pus, surrounding which are smaller nodules containing caseous matter. One of the nodes in the mesenteric chain is enlarged and shows an incipient focus. Carcass condemned.

RETEST OF TWENTY-SIX COWS IN DRY BARN.

Six months having elapsed since the nonreacting cows were placed under sanitary conditions in the renovated small barn, it was deemed advisable to again subject them to the tuberculin test in order to discover if tuberculosis had been latent in any of the cows at the time of the first injection. Of the 26 cows injected, 25 had failed to react in the previous test (see p. 9), while the remaining cow (No. 421) was near the end of the period of gestation at the time the first injection was made. The result of the second test (see below) shows that 8 of the previous nonreacting cows gave a decided reaction, while No. 421 failed to respond. These reacting animals were at once removed to the infected barn and the stalls previously occupied by them thoroughly cleaned and disinfected. As several were milking well they were not disposed of at once, but were continued in the dairy for varying periods and their milk thoroughly sterilized before using.

Retest of 26 cattle on November 25 and 26, 1900, which did not react when the entire St. Elizabeth herd was first tested, May 2 and 3, 1900.(a)

Number of cow.	Temperature taken.	6 a. m.	9 a. m.	12 m.	3 p. m.	6 p. m.	9 p. m.
No. 359	Nov. 25	102.0°	101.6°	101.8°	101.8°	101.1°	102.0°
	Nov. 26	101.4	101.2	100.2	101.4	101.0	100.4
No. 360	Nov. 25	101.2	101.2	101.0	101.7	101.2	101.2
	Nov. 26	101.4	101.0	101.2	100.6	101.2	101.0
No. 361	Nov. 25	102.5	102.6	102.2	101.2	101.0	101.4
	Nov. 26	102.0	101.8	102.0	102.9	102.7	102.5
No. 362	Nov. 25	101.6	101.5	102.3	102.3	101.6	101.9
	Nov. 26	104.7	105.8	107.0	106.7	106.0	106.4
No. 363	Nov. 25	102.0	101.6	101.8	101.8	101.9	101.6
	Nov. 26	102.1	103.6	105.7	106.3	105.6	105.2
No. 364	Nov. 25	102.0	101.8	101.6	101.8	101.4	101.6
	Nov. 26	102.9	104.2	106.9	106.6	105.6	105.3
No. 365	Nov. 25	100.8	102.0	101.6	101.8	102.0	102.0
	Nov. 26	101.7	101.6	101.4	102.0	102.4	103.0
No. 366	Nov. 25	101.4	101.2	101.0	101.4	100.6	102.0
	Nov. 26	101.5	101.1	101.4	102.0	102.4	103.0
No. 367	Nov. 25	102.0	101.8	101.4	101.2	101.5	101.6
	Nov. 26	101.6	101.5	101.4	101.4	101.4	101.2
No. 368	Nov. 25	101.6	101.5	101.0	101.4	102.0	101.0
	Nov. 26	101.5	101.4	101.0	101.6	101.5	101.4

a Tuberculin injections made at 10 p. m., November 25.

Retest of 26 cattle on November 25 and 26, 1900, which did not react when the entire St. Elizabeth herd was first tested, May 2 and 3, 1900—Continued.

Number of cow.	Temperature taken.	6 a. m.	9 a. m.	12 m.	3 p. m.	6 p. m.	9 p. m.
No. 369	Nov. 25	101.5°	101.4°	101.6°	101.7°	101.4°	101.7°
	Nov. 26	101.6	101.6	101.6	101.7	101.6	101.3
No. 370	Nov. 25	102.0	100.6	101.4	101.3	100.7	100.6
	Nov. 26	101.5	101.5	101.6	101.7	101.0	101.2
No. 371	Nov. 25	100.6	101.0	100.6	100.0	102.0	100.2
	Nov. 26	101.2	101.4	101.4	102.5	102.2	101.6
No. 378	Nov. 25	102.0	101.7	101.4	102.2	100.6	101.2
	Nov. 26	101.3	101.4	101.8	105.0	105.7	104.6
No. 379	Nov. 25	101.5	101.6	101.4	101.4	101.5	101.0
	Nov. 26	102.5	101.2	101.2	101.2	101.8	101.5
No. 380	Nov. 25	103.2	102.2	101.4	100.5	101.0	101.2
	Nov. 26	102.7	102.8	105.2	104.1	103.0	103.3
No. 381	Nov. 25	101.7	102.0	101.6	101.5	101.2	101.8
	Nov. 26	101.8	101.5	101.5	101.6	101.4	102.4
No. 384	Nov. 25	102.0	101.5	101.4	101.4	101.0	101.3
	Nov. 26	102.6	104.6	105.6	106.2	106.0	104.8
No. 419	Nov. 25	101.6	101.8	101.4	101.4	100.6	101.0
	Nov. 26	103.0	104.8	105.8	105.2	103.6	103.0
No. 421	Nov. 25	101.6	101.7	101.5	100.8	101.5	101.4
	Nov. 26	101.4	101.5	101.2	101.2	101.6	101.0
No. 938	Nov. 25	101.5	100.0	100.9	100.8	101.0	101.2
	Nov. 26	101.4	101.0	100.8	101.2	101.0	100.8
No. 940	Nov. 25	102.2	102.0	102.0	101.8	101.0	101.2
	Nov. 26	102.0	102.0	101.5	101.6	102.0	101.0
No. 944	Nov. 25	102.0	101.8	101.3	101.7	101.2	101.4
	Nov. 26	101.7	101.7	102.9	103.9	104.3	103.6
No. 954	Nov. 25	101.2	101.5	101.1	101.2	99.6	100.8
	Nov. 26	101.2	101.6	101.8	102.0	102.0	100.4
No. 959	Nov. 25	101.3	101.3	101.5	101.6	100.4	101.0
	Nov. 26	102.0	101.7	101.4	101.8	103.2	102.6
No. 960	Nov. 25	101.8	102.2	101.4	101.5	100.4	101.6
	Nov. 26	102.3	101.9	101.8	102.2	101.8	101.2

It will be seen that 8 of the above cattle gave a decided reaction, and they were at once segregated and placed in quarantine in the infected barn. Owing to the decision that a nontuberculous herd should be established, these animals were slaughtered from time to time, and a brief description of the cows, together with postmortem notes, are given below.

Cow No. 362.—Roan Shorthorn grade; 6 years old; bought three years ago; weight, 1,090 pounds; in good flesh and apparently in healthy condition.

Postmortem at Rosslyn, Va., March 8, 1901: A number of small tuberculous nodules in the posterior mediastinal gland containing a calcareous deposit in the center. Large abscess in liver, not tuberculous. Carcass passed.

Cow No. 363.—Grade Jersey; 6 years old; purchased one year ago; weight, 790 pounds; animal in fair condition and apparently healthy.

Postmortem at Bennings, D. C., March 19, 1901: Caseous nodules about the size of an acorn in the anterior portion of the left ventral lobe. The udder shows a fibrous induration of the posterior quarters and both supramammary glands are enlarged and watery, but a subsequent microscopic examination did not reveal the presence of the tubercle bacillus. Carcass passed.

Cow No. 364.—Roan Shorthorn grade; dehorned; 5 years old; bought three years ago; weight, 1,035 pounds; aborted November 2, 1900. In thrifty condition, but shows an enlarged submaxillary gland.

Postmortem at Rosslyn, Va., March 6, 1901: Left submaxillary gland enlarged, the size of a hen's egg, containing caseous deposit with calcareous center. One small calcareous tubercle in the posterior mediastinal gland. Carcass passed.

Cow No. 373.—Spotted Ayrshire grade; 12 years old; raised; animal appears normal and in fair condition; weight, 840 pounds.

Postmortem at Bennings, D. C., March 19, 1901: Principal lobes of both lungs show a number of nodules ranging in size from a hazelnut to a walnut. On section they are seen to have undergone cheesy degeneration. Right posterior pharyngeal gland is greatly enlarged, with contents caseated. Posterior mediastinal glands contain several small yellowish tubercles of a softened consistency. Carcass condemned.

Cow No. 380.—Blue roan; common stock; 9 years old; purchased in Virginia about eighteen months ago; animal appears thrifty and is a good milker.

Postmortem at Fowlers, D. C., April 18, 1901: Three small caseated centers of tuberculosis in right posterior pharyngeal lymph gland. Right bronchial gland greatly enlarged and completely degenerated. Contains a cheesy detritus with center slightly calcified. Carcass passed.

Cow No. 384.—Grade Shorthorn; 8 years old; bought three years ago; condition good; weight, 1,015 pounds.

Postmortem at Fowlers, D. C., May 19, 1901: The posterior mediastinal glands are enlarged and contain several soft, yellowish tubercles, varying from one-eighth to three-fourths of an inch in size. Left bronchial gland has an incipient focus of tuberculosis. The surface of the liver shows three or four necrotic areas, which do not reveal the tubercle bacillus on microscopic examination. Entire chain of mesenteric lymph glands appear normal. Carcass passed.

Cow No. 419.—Red; common stock; 3 years old; 1 calf; bought one year ago; in fair condition and appears to be thrifty; weight, 910 pounds.

Postmortem at Fowlers, D. C., May 31, 1901: Two small nodules, size of hazelnuts, in principal lobe of right lung and three similar foci in ventral lobe of the opposite lung. One pea-sized focus in anterior mediastinal lymph gland. Carcass passed.

Cow No. 944.—Holstein grade; 4 years old; 1 calf; raised; appears healthy and in fair condition; weight, 745 pounds.

Postmortem at Fowlers, D. C., March 26, 1901: Cephalic lobe of left lung shows one tubercular focus, size of a pea, in a caseous condition. Left bronchial lymph gland contains a small focus in the semicalcareous stage. Other organs apparently normal. Carcass passed.

It is shown by the postmortem notes above that the lesions manifested at the autopsy were not excessive nor of a chronic nature, which would further indicate that the record of the tuberculin test for the first injection was correct, and that the cows had been infected subsequent to the first test, or that they were even then infected, but without the bacilli being in sufficient quantity to cause a pyrexia in consequence of the tuberculin. The only cow in which the disease was in any way extensive was No. 373, and, as this animal was not slaughtered until four months after the second test and ten months after the first injection, ample time had elapsed to account for the extent of the infection even after the second test.

The third tuberculin injection was made three months later, and of the 18 cows tested not a single one showed a rise of temperature.[a] Shortly after this the superintendent of the Insane Asylum placed a

[a] Owing to these temperatures being normal, it was not deemed essential to record them here.

competent veterinarian in charge of the cattle, and it will be of interest to know the results of the methods thus far pursued for the complete extermination and suppression of tuberculosis in this herd.

The tuberculous animals having been slaughtered, a new herd was started by the purchase of thrifty and vigorous grade cattle that successfully passed the tuberculin test. These cows are at present occupying the barns after thorough disinfection, a complete renovation of the premises, and with improved ventilation and hygienic surroundings in general. Thus having removed, so far as possible, the tubercle bacilli themselves and also their source, it remains to be seen what effect these sanitary measures will have upon the prevention of tuberculosis in the present apparently healthy herd. It has been repeatedly demonstrated in a practical manner that tuberculosis can be completely eradicated from an infected herd and the latter subsequently kept free from the disease, which leads to the belief that, in consequence of the methods of sanitation adopted for the herd under consideration and by occasional tuberculin tests, together with the purchase of only tuberculinized cattle, similar results may be attained in this instance.

SUMMARY OF RESULTS OF TUBERCULIN TESTS.

The result of the first tuberculin test of 102 cows shows a decisive reaction in 76 animals with 1 cow giving a suspicious rise. The second test gave 8 typical reactions out of 26 cattle injected. The third test demonstrated that the 18 cows tested were without the slightest suspicion of tuberculosis. Thus out of 146 individual injections but 1 reaction (cow No. 953) was considered questionable, and, as before mentioned, the postmortem on this animal indicated that the cause of the uncertain rise was probably occasioned either by the minute size of the lesions or the tendency toward encapsulation or both. It seems apparent from the results of the postmortem held on the 8 cows which reacted to the second test that these animals were either not diseased at the time of the first test or, if so, to such a slight degree as to render detection impossible by any known means. In no case where an animal reacted to the tuberculin test did the postmortem fail to show that the cause for the reaction had been tuberculosis. The remaining 18 nonreacting cows are in good thrifty condition, and may be presumed to be healthy after passing three tuberculin tests without giving the least suspicion of a rise in temperature. The length of the period between the injection of the tuberculin and the following reaction varies from eight to eighteen hours, and cow No. 70 is an excellent example of an animal that might be passed as sound if the subsequent temperatures are not followed for at least eighteen hours after the injection. Finally the results obtained from the test of these cows support the good reputation which tuberculin merits as a diagnostic agent.

CONCLUSIONS.

From the results of the experiments conducted in this laboratory, as well as from the majority of similar investigations quoted in this article, the following conclusions regarding the infectiousness of milk from tuberculous cows seem justifiable:

1. The tubercle bacillus may be demonstrated in milk from tuberculous cows when the udders show no perceptible evidence of disease, either macroscopically or microscopically.

2. The bacillus of tuberculosis may be excreted from such an udder in sufficient numbers to produce infection in experimental animals both by ingestion and inoculation.

3. That in cows suffering from tuberculosis the udder may, therefore, become affected at any moment.

4. The presence of the tubercle bacillus in the milk of tuberculous cows is not constant, but varies from day to day.

5. Cows secreting virulent milk may be affected with tuberculosis to a degree that can be detected only by the tuberculin test.

6. The physical examination or general appearance of the animal can not foretell the infectiveness of the milk.

7. The milk of all cows which have reacted to the tuberculin test should be considered as suspicious, and should be subjected to sterilization before using.

8. Still better, tuberculous cows should not be used for general dairy purposes.

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U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF ANIMAL INDUSTRY—BULLETIN NO. 45.

D. E. SALMON, D. V. M., Chief of Bureau.

TAKOSIS, A CONTAGIOUS DISEASE OF GOATS.

A PRELIMINARY REPORT ON ITS NATURE, CAUSE, AND PREVENTION.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
Washington, D. C., March 2, 1903.

SIR: I have the honor to submit herewith a manuscript on "Takosis, a contagious disease of goats: A preliminary report on its nature, cause, and prevention," by Dr. John R. Mohler and Dr. Henry J. Washburn, chief and acting assistant chief, respectively, of the Pathological Division of this Bureau.

During the fall and winter of the past year reports of a chronic, highly fatal disease, which seemed to threaten the Angora goat industry in certain districts, reached the Bureau from several different States; and as the symptoms and postmortem lesions were entirely unlike any of those accompanying the known diseases which affect this species of animals, it was decided to investigate thoroughly the nature of the disease in question and, if possible, to determine the cause of the affection. Laboratory work soon resulted in bringing to light a micrococcus (*Micrococcus caprinus*) in the blood of the heart, lungs, and spleen, which experiments proved to be the cause of the disease. Filtrates were made and a series of experiments undertaken with the purpose in view of securing a preventive, and possibly a cure, of the disease. The paper submitted herewith shows that these efforts met with some success. The work so far done is fully described in this paper, and suggestions for preventing the disease are offered. It is believed that all this will be useful to the industry which has so recently received such widespread attention, and I therefore recommend the publication of this manuscript as Bulletin No. 45 of this Bureau.

Respectfully,

D. E. SALMON, *Chief of Bureau.*

Hon. JAMES WILSON, *Secretary.*

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TAKOSIS, A CONTAGIOUS DISEASE OF GOATS: A PRELIMINARY REPORT ON ITS NATURE, CAUSE, AND PREVENTION.

By JOHN R. MOHLER, V. M. D.,
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PRELIMINARY REMARKS.

It will surprise many readers to learn that there exists a disease of any kind sufficiently virulent to kill a goat. As popularly regarded, this animal haunts the backyards and alleys in the suburban districts of our cities, where he picks up various articles of sustenance which would prove fatal if consumed by any other species of animal. Kept under these conditions, he usually presents such a cheerful and healthy appearance that he would at once be pronounced able to combat successfully anything that should come his way, even an infectious disease.

While admitting that the common goat (*Capra hircus*) is susceptible to comparatively few ailments, it will be shown by the following article that the Angora, after many generations of careful breeding and selection under favorable conditions, has developed a perceptible retrogradation in vitality and power of resistance against disease and has been seriously and fatally affected in many sections of the country by a disease not accredited to its prototype. During the fall and winter of the past year, reports of a chronic, highly fatal contagious disease, which seemed to threaten the Angora goat industry in certain districts, reached this Bureau from several different States; and, as the symptoms and postmortem lesions described in the letters were entirely unlike any of those accompanying the known diseases which affect this species of animals, arrangements were made to secure the viscera of an animal that had died after showing characteristic symptoms of the disease in question, in order to investigate the nature, and, if possible, the cause of the affection. As a result, the entire viscera, including the head and intestinal canal of a goat that succumbed to the disease, was received in good condition from Pennsylvania during December, 1901.

The inoculated culture media and cover-glass preparations made from the heart's blood, lungs, and spleen showed a small micrococcus arranged in the form of a diplococcus, and occasionally in tetrads or short chains. Two other organisms were obtained from the liver and lungs—one a large spore-bearing rod and the other a motile, peptonizing bacillus; but, after a bacteriological examination and inoculation tests, they were shown to be obvious contaminations, the result of postmortem invasion. A similar study of the micrococcus isolated from the heart's blood revealed its pathogenic properties to mice and guinea pigs, and it was thereupon determined to make a more extended investigation of the disease. Shortly after, one of the writers was enabled to visit a large flock of Angora goats, among which the disease was prevalent, with deaths occurring daily, and it is principally from the information acquired from an investigation of the disease in this outbreak that the following article has been prepared.

NAME OF DISEASE.

Takosis.—It is with considerable hesitation that a specific designation for the disease in question is suggested at this time, and although generally the coinage of names is to be avoided, still it seems essential and preeminently of importance to individualize this affection by means of a descriptive term. For this purpose the name Takosis is proposed. It is derived from the Greek τήκω, meaning to waste, to cause to waste away, and is thought sufficiently descriptive and accurate to meet the desired requirements.

HISTORY OF OUTBREAK.

On arriving at the farm where the Angora goats were kept, it was learned from the owner that goats had been maintained on the premises for several years, but the majority of the flock had been purchased in Texas six weeks before the outbreak. The disease had commenced its ravages in November, when the animals had been on brush land in the mountains. Laurel poisoning was suspected, as several goats had died from this cause during the previous summer, but on closer observation this opinion was disregarded, not only on account of the different symptoms manifested, but also from the chronic course of the disease. The general weakness, loss of flesh, and extreme debility of the animals then suggested intestinal parasites as the cause, and worm powders were administered for a period sufficiently long to obtain results but without success. It was then thought desirable to change the pasture, and accordingly the goats were brought down from the mountains to the farm, where they were stable-fed. The majority were placed on the ground floor of a large hillside barn in various-sized pens to accommodate the several bunches into which the animals had been graded.

The remainder were allowed the freedom of the yard and hillside and were stabled on the barn floor proper between two haymows. Feeding troughs and mangers had been erected, and this provision was in every way satisfactory for the purpose for which it was designed. The barn, pens, and yards in which the animals were kept appeared to be in good sanitary condition and well adapted to the sheltering of goats. The feed consisted of corn, oats, and hay in ample quantities and in proper proportion, and the goats at all times took readily to this diet, even up to the time of death. In fact, it was a curious circumstance to observe, on postmortem examination of a large proportion of these animals, that the stomachs were filled with recently partaken food. And the goats could be seen eating hay sometimes with evident relish, at other times in a listless manner, when their vitality was so reduced as to make standing impossible. Despite the change from the mountain pasture, including an entire change of surroundings as well as diet, deaths continued with alarming frequency, and the services of the Bureau were solicited in combating the affection.

The continuance of the fatalities after a complete change of diet and shelter, the regularity of the course of the disease, the apparent similarity of the symptoms in all the affected animals as well as the evident spread of the affection from one animal to another, led the owner to be strongly suspicious that he was dealing with a contagious disease, and he therefore constructed a pen in a corner of the basement wherein all the affected goats were placed. This proved to be a step in the right direction, but the disease became so prevalent that an additional pen was brought into service. As no endeavor had been made to separate the latter hospital from the remaining pens, the results were not so beneficial as they might have been had this pen been entirely isolated, as was the original hospital. As it was, the larger unaffected does and bucks were able to hurdle the fence and thus carry the infectious principle back to the healthy goats. This was at once brought to the notice of the owner, and steps were immediately taken to keep the healthy animals out of the infected pen as well as to isolate more thoroughly the inclosed goats by securely boarding up these quarters. This method of segregating the diseased animals, together with the disinfecting measures adopted, probably resulted in confining the ravages of the affection to a minimum.

SYMPTOMS.

The disease presents many of the symptoms usually accompanying a parasitic invasion and is characterized by great emaciation and weakness, with symptoms of diarrhea and pneumonia. In the early stages of the affection there is usually little to indicate that anything is seriously amiss with the animal. The first observable symptom mani-

fested is the listless and languid appearance of the animal, evidenced by its lagging behind the flock, and is usually accompanied by a drooping of the ears and a drowsy appearance of the eyes. The pulse is slow and feeble and the temperature is elevated slightly at first, but becomes subnormal a few days before death. The highest temperature observed in the natural disease was 104.1°, and the lowest, in a prostrated animal a few hours before death, registered 99.7° F. Snuffling of the nose, as in a case of coryza, with occasional coughing is sometimes in evidence.

As the disease advances the animal moves about in a desultory manner, with back arched, neck drawn down toward the sternum, and with a staggering gait. Rumination is seldom impaired. The appetite, while not so vigorous, is still present, though capricious, and the affected animal shows plainly that the ravages of the disease are rapidly overcoming the restorative elements derived from the food. The fleece is usually of good growth and presents a surprisingly thrifty appearance when the condition of the animal is taken into consideration. All the exposed mucous membranes appear pale and the respirations are accelerated and labored. The goats finally become so weak that they are readily knocked down and trampled upon by their fellows. If picked up they may move off slowly and eat a little, but within a few hours are down again, and in this way linger for several days, shrinking to about half their natural weight, and occasionally bleating or groaning, with head bent around on the side or drawn down to the sternum. A fluid discharge from the bowels of a very offensive odor is usually observed in the last few days of life, but this symptom is not constant.

COURSE AND SUSCEPTIBILITY.

This disease may assume a subacute or chronic type, usually the latter. According to our own observations, the animal dies of inanition in from eight days to six or eight weeks. Several owners have reported deaths after only two or three days of illness, but the goats doubtless had been affected for a longer period, although not noticed on account of their mingling in the flock. It is the consensus of opinion among the breeders interviewed that many of the animals succeeded in living for weeks, but gradually became weaker and more debilitated, finally dying in a comatose condition. In no instance have we observed or heard of the natural recovery of an animal after once the symptoms of takosis were noticed.

The younger goats seemed to be the most susceptible to the disease, although the old animals were by no means immune. The does, wethers, and also the bucks became affected, and for a period of almost two months (December and January) newly diseased goats varying in number to as many as 11 were removed to the hospital daily on the

Pennsylvania farm where the disease was investigated. Owing to the preponderance of does at this place, it appeared that the affection was most virulent for them, but this fact has not been sustained by reports subsequently received from other sections.

PATHOLOGICAL ANATOMY.

As already indicated, the general appearance of the carcass simulates that produced by a wasting disease. The visible mucous membranes are pale and anemic, while the fleece, which appears somewhat dry and lusterless, furnishes a shroud for the extremely emaciated condition that becomes plainly perceptible on skinning. This masking quality of the hair prevents an accurate estimate of the condition of the animal by the eye alone, and necessitates handling of the individual to appreciate to the full extent the inroads made by the affection. The same anemic condition of the subcutaneous and muscular tissues is observed on eviscerating the carcasses. The lungs in most cases are the seat of a peculiar diversified inflammation, never of a remarkable extent. The external appearance of these organs is at times mottled, caused by a few congested areas, several patches of an iron-gray color similar to areas of pneumonia during the process of absorption, and normal tissue. On section through the reddened patches, a frothy mucus may exude from the bronchioles, and in one case numerous punctiform hemorrhages were observed on the sides of the incision. This tissue, while not so buoyant as a normal portion would be, nevertheless floats when placed in water.

The heart in all cases is pale and dull, its tissue soft and flabby, while inflamed areas, more or less penetrating, are present at times on the epicardium about the auricular appendages, and at other times on the endocardium, especially that lining the ventricles. These hemorrhagic patches consist of either pure extravasated blood or blood mixed with serum, which gives them a more diffuse appearance and a gelatinous consistence. The pericardium is slightly thickened, and usually contains a small increase of fluid tinged with blood. The liver usually appears normal, although the gall bladder is frequently distended with pale-yellow watery bile. The kidneys are anemic and softened. The cortex appears slightly thicker and paler than normal, and contrasts strongly with the darker pyramids. The capsule strips off easily from the parenchyma of the organ. In one instance several pale areas simulating anemic infarcts were observed under the capsule extending into the cortex, which probably resulted from the compression of the capillaries by the swollen parenchymatous cells. The presence of albumin in the urine was detected by the nitric-acid test. The spleen appears atrophied and indurated, and on section the fibrous tissue far exceeds the splenic pulp. Attachments by fibrous adhesions may fix the spleen to the diaphragm or the neighboring organs. The

intestines may contain normal fecal matter or semifluid feces of a disagreeable odor. The surface of the mucous membrane is at times covered with a slimy mucus or plastic exudate, and the appearance is that of a chronic catarrh associated with necrosis of the mucosa. The brain and spinal cord of four cases were examined, but without discovering any apparent alterations. As an illustration of the ravages of this disease, the following brief notes are recorded upon two Angora goats which were sent from the same flock to the laboratory in order that work previously done and facts already established might be confirmed.

The larger of these was a female, one year old, greatly emaciated, and was at no time after its arrival at the laboratory able to stand alone, even when lifted up and placed on its feet. It was still able and willing to eat and drink, but it showed plainly that the ravages of the disease were rapidly getting the best of the reconstructive forces. The fleece was of good length, and appeared more glossy than that naturally found on animals so seriously emaciated. All of its exposed mucous membranes were pale. Temperature subnormal, pulse imperceptible, and heart's action feeble and irregular. Occasional bleating was heard, and the goat seemed in great distress. Because of the helpless condition of this animal it was killed the second day after its arrival, and at the autopsy the following conditions were noted:

Muscular tissue pale and anemic; lymph glands enlarged, but of normal color; the superficial inguinal glands were especially noticeable in regard to this condition. The lungs were affected throughout with a finely diversified pneumonia. There were three small areas (0.5 cm. to 2 cm. in diameter) of complete hepatization irregularly located near the surface of the left lung, while the remaining portions of both lungs were grayish red in color. The pleura showed no lesion. The heart muscle was pale, and directly beneath the epicardium were a number of dark hemorrhagic areas which ranged in size from a pin head to a large bean.

The pericardial sac contained from 250 to 300 c. c. of slightly reddened nonviscid fluid. Liver apparently normal. Spleen shrunken and pale. The kidneys appeared anemic and somewhat flabby. The bladder contained about 30 c. c. of albuminous urine. The small intestines were inflamed and their internal surface was covered, wherever the inflammation existed, with a slimy, malodorous deposit. The stomachs and large intestines were normal, as were also the brain and spinal cord. The general appearance of the affected animal would lead one to suspect a verminous affection of the alimentary tract. The emaciated, anemic condition of the animal, as well as the persistent appetite associated with diarrhea, would strengthen such an opinion. For this reason a careful examination of the stomachs and intestines was made. The only result, however, was the discovery of three

specimens of the comparatively harmless *Cysticercus tenuicollis*, which were attached to the external surface of the rumen. There was no trace of animal parasites to be found in the stomachs, intestines, or other organs.

Cultures made from the heart, lungs, spleen, liver, and mediastinal lymph gland proved positive, and in most of these instances the micrococcus was grown at once in pure culture.

The smaller of the two goats received at the laboratory during the latter part of March was a wether about one year of age. It was much emaciated but still active on its arrival. Its appetite was unimpaired. Physical examination made on the day previous to its death showed a temperature of 102.5° F.; respiration, 32; pulse, 112, irregular and somewhat fluttering. The exposed mucous membranes were pale and the eyes dull and lusterless.

This animal died on the third day after its arrival at the laboratory. At the postmortem examination there was found to be general emaciation of the muscular tissues, which appeared whitened and bloodless. About 200 c. c. of fluid was present in the pericardial sac. It was reddish, thin, and appeared like greatly diluted blood. The lungs floated in water, but presented the same grayish red appearance that has already been noted in the lungs of its mate. The spleen was small, pale, and firm. The kidneys appeared swollen and anemic. The bladder was empty. The liver showed no lesions. The mucosa of the abomasum was slightly congested. The intestines were empty throughout, and appeared but moderately inflamed in the region of the duodenum and jejenum. The rumen contained a large quantity of undigested food and was in a normal condition. The brain and spinal cord presented an equally healthful appearance. Search for animal parasites was without result, although the visceral organs were carefully scrutinized.

Positive cultures were obtained from the pericardial and peritoneal fluids and from the liver and lungs.

BACTERIOLOGY.

During the visit to the affected flock, several goats were slaughtered in various stages of the disease and tubes of agar media (on account of their ease of transportation) were inoculated from the various organs and heart's blood as well as cover-glass preparations obtained from the juices of these tissues. Subsequent examination of the cultures and slides showed the presence of a micrococcus, usually arranged in the form of a diplococcus, which was found to be in pure cultures from the heart's blood, spleen, kidneys, and pericardial fluid, and essentially so in the tubes inoculated from the other organs. Inoculations made from the spinal cord were negative. Identical organisms have since been obtained from Angora goats affected with the disease from several

different localities and their identity proved by cultural examination and inoculation tests. Various other micrococci to which the one under consideration bears a resemblance were carefully compared, but we have not been able to identify the latter with any of the previously described organisms, although it presents in a parallel series of cultures many characteristics in common with the *Staphylococcus pyogenes albus*. Owing to the scarcity of any preeminently conspicuous lesion in the affected goats, and to the absence of any typical morphologic or cultural characteristic of the micrococcus, it was thought desirable to derive its name from its host, especially as it did not appear to be pathogenic for pigs, dogs, and chickens which fed upon the diseased carcasses on one of the infected premises, or for horses, cattle, and sheep that were quartered in an adjoining portion of the same stable. Therefore the name *Micrococcus caprinus* sp. nov. is suggested.

MORPHOLOGY.

The specific organism of takosis appears in fresh bouillon cultures as a spherical or oval micrococcus with a diameter of 0.8 to 1 μ. In these cultures it is single or in chains of two, three, or four elements, but most frequently in pairs, as diplococci (Pl. I, fig. 1), with a diameter transverse to the axis of the chain greater than the longitudinal diameter. There is quite a variation in the size of the cocci, probably due to the increase in the size of the organism preparatory to the act of fission. As the cultures become older the cocci develop a stronger tendency to form chains, and after remaining in the incubator at 37° C. for three or more days chains of four to six elements are at times observed, as are also irregular clumps of cells which collect in masses of varying sizes. When they assume this grouping tendency no oval forms are to be found and each of the organisms is strictly spherical in outline. In the tissues they are frequently seen to deviate from the spherical and assume somewhat of a lancet shape, with the pointed extremities in apposition. This same form has been met in samples of blood freshly drawn from the ear of an affected goat. The elements forming pairs are frequently very unequal in size and are not always of uniform shape. (Pl. II, fig. 1.) They are seen to possess the ability of executing strong Brownian movements, but make no progress across the field of the microscope. No capsule has been observed surrounding these micrococci either in the blood or when obtained from cultures, nor have spores, vacuoles, or crystals been seen. The organism stains indistinctly and with difficulty with Loeffler's methylene blue and the standard aqueous aniline dyes, with the exception of gentian violet, but carbol-fuchsin and Gram's and Gram-Weigert's stains give clear uniform coloration to the cells.

BIOLOGY.

The organism develops as an aerobe, but it also supports an active growth when deprived of oxygen, and is, therefore, a facultative anaerobe. It grows both on solid and in liquid culture media with the usual degree of alkalinity, but also multiplies in those that give an acid reaction of +1.5 phenolphthalein.

A temperature of 37° C. is most favorable for its development, but it will also grow at room temperature. In the latter case the growth is more tardy and not so profuse.

CULTURAL CHARACTERISTICS.—*Bouillon.*—In neutral (phenolphthalein) peptonized beef broth a slight uniform cloudiness is caused by the growth of the organism within ten hours at 37° C. This condition increases until, after twenty-four hours at the above temperature, the cloudiness has become quite marked and uniform. At this time a deposit may be noticed beginning to gather on the bottom of the tube. In three days this sediment has increased in volume and the turbidity of the supernatant fluid has been lost. The deposit is pearl gray in color, and on agitating the tube it rises slowly in the shape of a twisted, ropy, coherent mass. A delicate marginal ring on the side of the tube is usually produced. No pellicle is formed nor can any characteristic odor be detected. The reaction of bouillon in which this organism has been growing for five days becomes decidedly acid, +1.7 phenolphthalein, and continues to increase in acidity subsequently.

Agar.—Growth upon the surface of slant agar occurs in twenty-four hours in the form of a white, glistening granular streak composed of numerous confluent colonies. This narrow line of growth becomes more extensive and reaches its maximum width on the third or fourth day, when it shows a ceraceous, at times granular, surface, with irregular wavy margins. In stab cultures the growth appears within 24 hours as profuse, small, grayish white, closely aggregated globules, so densely packed together as to give an irregular nodulose appearance macroscopically along the entire length of the line of puncture. The only colony which develops at the point of entrance of the needle is at first pearly white, but after twenty-four hours it assumes a grayish color in the center, with a lighter periphery of an equal breadth. It has a slightly granular center, a regular border, and is from 8 to 10 mm. in diameter. The surface growth on agar plates appears as smooth white, flatly convex, ceraceous colonies, about 1.5 mm. in diameter, with entire borders. By reflected light these surface colonies appear homogeneous, but, observed by transmitted light, they present a white center and pearly margin. The submerged colonies develop as light brownish foci with regular outlines. They may be round or lentil shaped, but are always minute in

size. No characteristic differences in growth of this organism have been observed when sown on glycerin-agar or on serum-gelatin-agar.

Gelatin.—In this medium the growth is slower, evidence of fertility not appearing until forty-eight hours. In stab cultures the line of puncture is occupied by numerous nodulose milk-white colonies that have apparently coalesced, and which extend to the extreme end of the track. When examined by the aid of the hand lens, they appear as closely aggregated individual colonies, with regular outlines and presenting a beaded appearance. These colonies are more minute than in agar, and the growth that appears on the surface, though similar in consistence, is likewise thinner and less profuse than parallel agar colonies. The organism will not liquefy gelatin until several generations have been grown upon artificial media. After a number of subinoculations the peptonizing of the gelatin commences on the seventh or eighth day, and later as early as the fourth or fifth day, when the surface growth is seen to sink, following which liquefaction is very rapid, and may reach the bottom of the tube in forty-eight hours, leaving a funnel-like track in its wake. The adjoining medium is then attacked, and within ten days after inoculation the contents become fluid, with a white pellicle on the surface. The appearance of the gelatin-plate colonies which develop on the second or third day is probably of a more milk-white color, and thinner and slightly smaller than those in agar, but otherwise are similar. Liquefaction does not commence until the fourth or fifth day, sometimes the seventh day, and this occurs only after continued subinoculations.

Blood serum.—The organism grows steadily on coagulated blood serum. The colonies coalesce, forming a narrow, compact line of whitish color, with edges slightly elevated above the level of the body of the growth. The water of condensation at the base of the serum slant is clouded and contains a white sediment. As the cultures become older, or after seven or eight days' growth, they assume a brownish color. In this work the serum used was obtained from the blood of a dog and was freshly prepared immediately preceding its use.

Potato.—When a loopful of a vigorous bouillon culture is sown upon the surface of potato, the growth that ensues along the line of inoculation inside of thirty-six hours is slight, moist, and glistening. In forty-eight hours it appears granular and rather feeble, like a cluster of dewdrops. Growth ceases by the third day, at which time the granular surface, with the aid of the hand lens, appears to be made up of minute individual raised colonies of a ceraceous nature that have become confluent.

Milk.—Growth develops rapidly when tubes of this medium are inoculated, but the only manifestation of the development during the first twenty-four hours is a slight deposit observed at the bottom of the tube. No change occurs in the appearance of the milk until the

Description of Plate I.

Fig. 1. Twenty-four-hours'-old bouillon culture of *Micrococcus caprinus* stained with gentian violet. Camera lucida drawing made at stage level with Zeiss No. 4 compensating ocular and 2 mm. oil immersion.

Fig. 2. Forty-eight-hours'-old milk culture stained with gentian violet. Camera lucida drawing made at stage level with Zeiss No. 4 compensating ocular and 2 mm. oil immersion.

Description of Plate II.

Fig. 1. Cover-glass preparation from lung of goat No. 2, dead as a result of natural infection. Stained with gentian violet. Camera lucida drawing made at stage level with Zeiss No. 4 compensating ocular and 2 mm. oil immersion.

Fig. 2. Cover-glass preparation of blood from posterior auricular vein of Angora goat No. 23, removed aseptically seven days before death from takosis. Stained by Gram's method, followed with eosin. Drawing with camera lucida at stage level with No. 6 compensating ocular and 2 mm. oil immersion and increased six diameters.

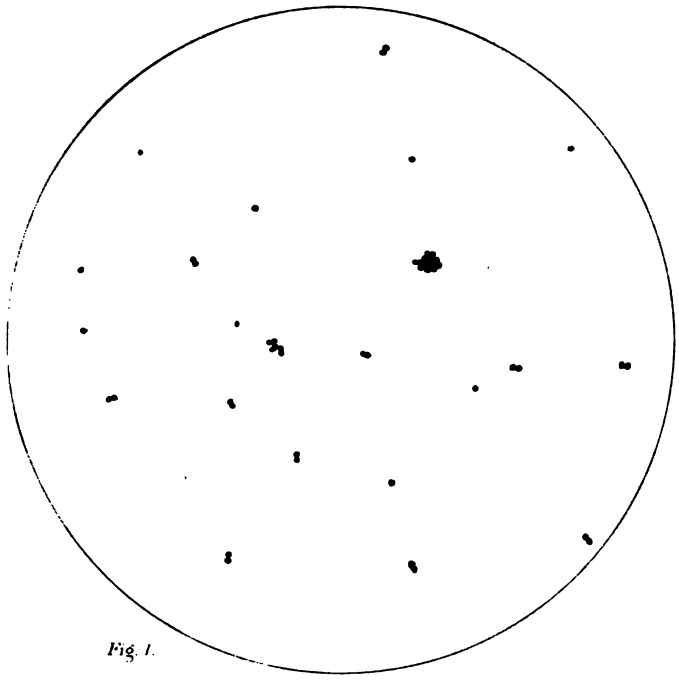

Fig. I.

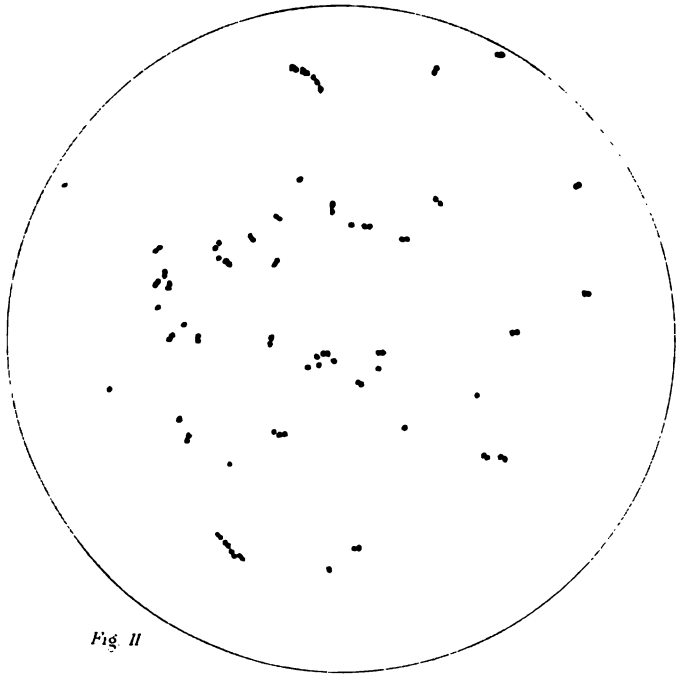

Fig. II

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MICROCOCCUS CAPRINUS FROM
(1) BOUILLON AND (2) MILK CULTURE MEDIA

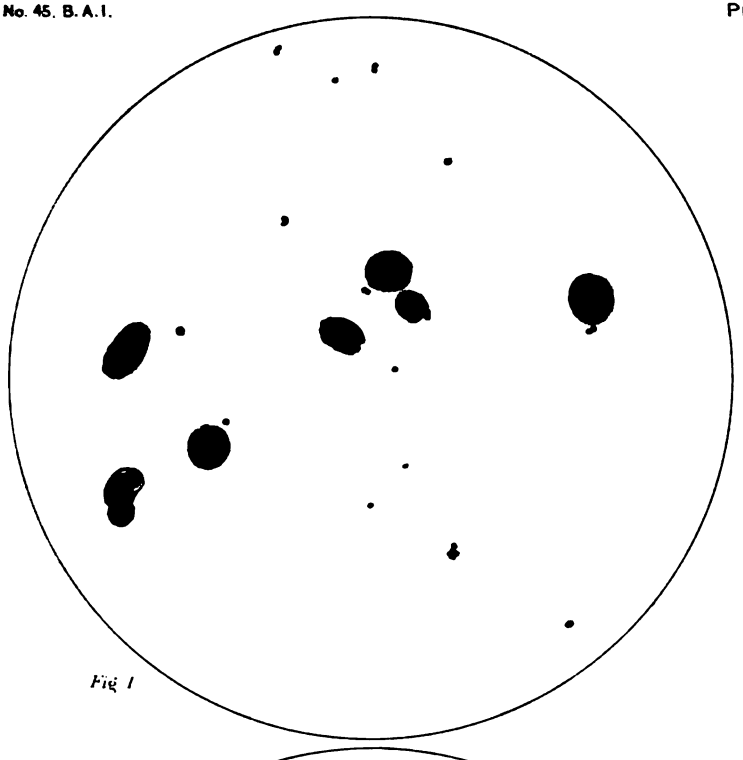


Fig I

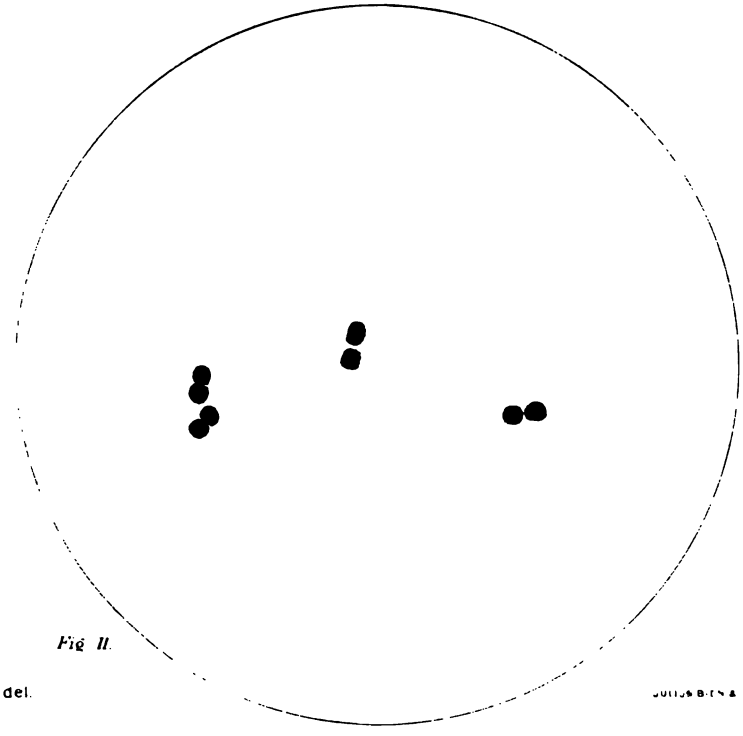
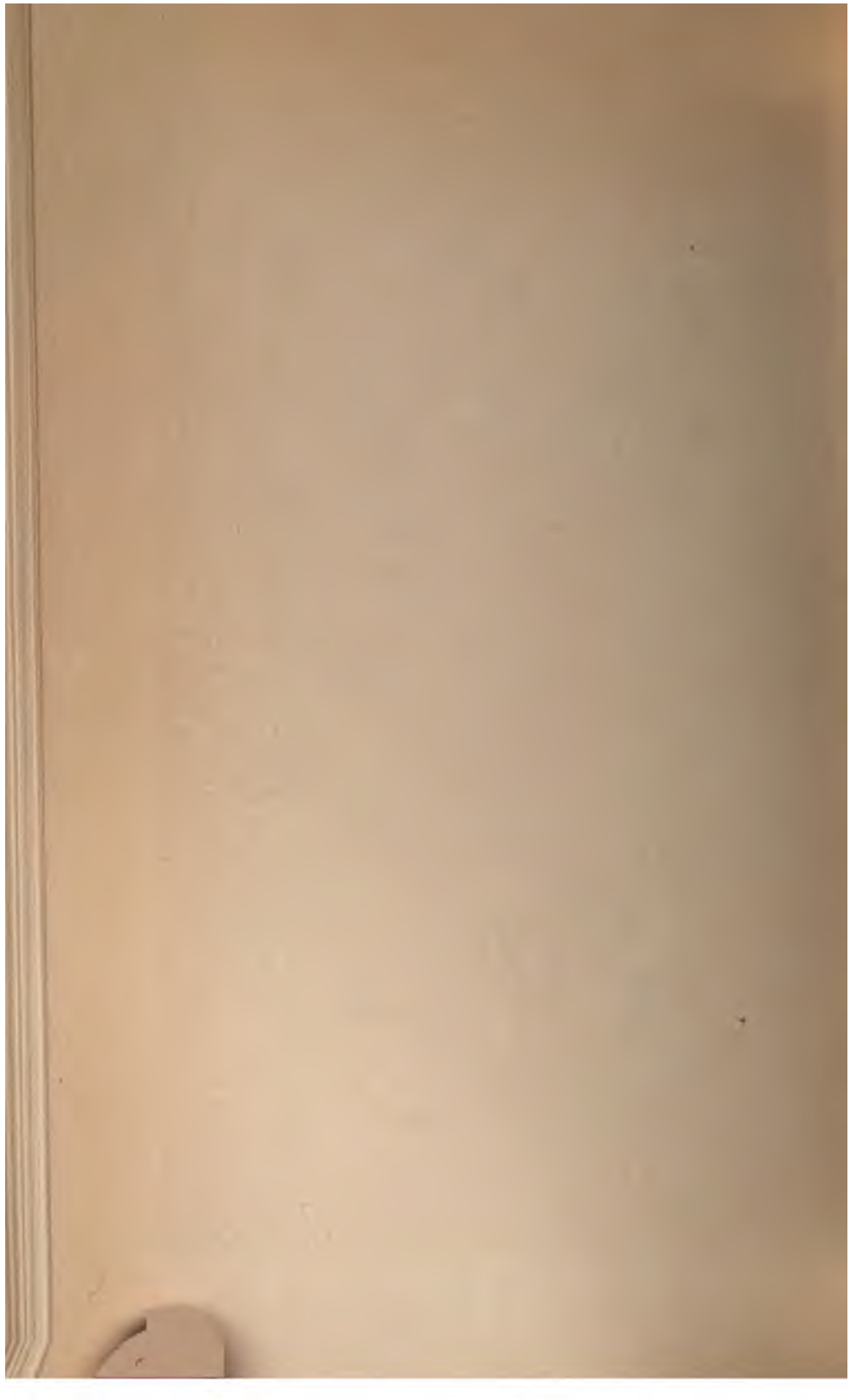


Fig II.

aines, del.

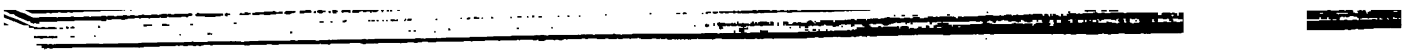
MICROCOCCUS CAPRINUS FROM THE
(1) LUNG AND (2) BLOOD OF ANGORA GOATS



Angora Goat No. 27, Six Days Before Death from Takosis.

Fig. 1.—Angora Goat from Maryland Flock; Photographed Three Days Before Death.

Fig. 2.—Same as Fig. 1. Position Assumed After Exhaustive Efforts to Regain Its Feet.



third or fourth day, when the medium becomes firmly coagulated in one mass. Within the following twenty-four hours the coagulum becomes partially peptonized and a transparent odorless whey is collected at one side of the slightly inclined tube, or at the top, if the tube is kept in a vertical position. This separation has been observed in various instances to commence from the fourth to the eighth day, and is usually completed after twenty-four to thirty-six hours, at which time the solid curd takes up from one-third to one-half of the volume of the medium, and either adheres to one side or occupies the bottom of the tube.

Litmus milk is changed to a delicate pink on the third day, owing to the development of acids, but no coagulum occurs until the fourth or fifth day, when a similar separation of the curd and whey takes place, as in plain milk with a greater tendency of the coagulum to form flocculi.

Fermentative action.[a]—The growth in bouillon, to which 1 per cent lactose, dextrose, and saccharose has been added, is rapid, especially with saccharose, but without any formation of gas. Inside of twenty-four hours the bulb becomes uniformly turbid in all these fluids, with a slight sediment in the branch and the appearance of growth at the extreme bottom of the closed tube. A faint marginal ring, but no pellicle, is observed. After three or four days the closed branch is uniformly clouded throughout, and remains so until the partial gravitation of the suspended elements, which occurs in six or seven days. Lactose bouillon cultures develop 5.1 per cent acid in growing for five days at 37° C., while dextrose cultures produce 3.9 per cent and saccharose bouillon cultures 3.5 per cent acid in the same time and under the same conditions. In sixteen days these media gave, respectively, a reaction of 7.7 per cent, 5.5 per cent, and 10.1 per cent. After thirty days' development the production of acid in lactose, according to the phenolphthalein test, was 9.2 per cent, dextrose 6.2 per cent, and saccharose 11.8 per cent. The production of acids is constant in all media.

Indol.—Cultures that have grown in Dunham's solution for two, seven, ten, and thirty days, respectively, were tested for the presence of indol by the method of Kitasato. In each case the result was negative.

Phenol.—Bouillon cultures of ten days' development, when submitted to Weyl-Lewandowski's test for phenol, threw down a precipitate of fine crystals which by microscopic examination proved to be phenol. The distillate failed to show the reaction for indol.

Thermal death point.—Tubes containing 1 c. c. each of bouillon cultures of a twenty-four hours' growth were exposed to a temperature

[a] The titre of these media was 1 phenolphthalein.

of 50° C. for varying periods of time, and fresh tubes of bouillon inoculated from them immediately afterwards. By this means it was shown that the tube which remained in the bath for three hours and fifteen minutes produced growth, although it was slight and tardy and the germ was evidently attenuated, while all that were exposed for three hours and twenty minutes or longer remained sterile. At 58° C. growth fails to occur after an exposure of only ten minutes. At 62° C. the organism was killed in six minutes, while it resisted a temperature of 70° C. for three minutes.

Desiccation.—The results obtained by the desiccation of the germ for twelve hours in the incubator at 37° C., with its subsequent exposure to the diffuse light of the room for a period of nine days, were sufficient to prove that sterility is thus produced.

Temperature requirements.—As previously mentioned, this micrococcus develops profusely at incubator temperature, while at 20° to 22° C. the growth is more tardy and less profuse. The maximum temperature at which the organism would multiply was found to be between 45° and 46° C. No growth developed at 47° C.

Effect of low temperature.—Tubes that were placed in a freezing mixture twice daily and kept in the ice chest under these conditions for four days were subsequently incubated at 37° C., with the result that they became fertile in every instance.

Action of disinfectants.—When the organism was subjected for twenty-six minutes to a 1–2,000 solution of bichloride of mercury, no growth followed, but an exposure to a 1–1,000 solution proved fatal in thirty seconds. A 1 per cent solution of carbolic acid sufficed to prevent development only after an exposure of fifty-seven minutes, while a 2.5 per cent solution caused the death of the micrococcus in thirty seconds. Formalin, in the strength of a 2 per cent solution, required an exposure of thirty-one minutes to prevent the subsequent development of the organism. These disinfecting solutions were all used at room temperature (about 21° C.).

PATHOGENESIS.

In order to demonstrate the pathogenic properties of the *Micrococcus caprinus* and to establish its etiological significance in the disease in question, the following inoculation experiments were conducted upon white mice, white and brown rats, guinea pigs, rabbits, chickens, dogs, sheep, and goats.

EXPERIMENTS WITH MICE.

Subcutaneous.—On January 11 a white mouse was inoculated intramuscularly near the base of the tail with 0.1 c. c. of an original bouillon culture from the spleen of Angora goat No. 2. In a few days it became languid and soon developed a diarrhea which termi-

nated in death on the twelfth day. The postmortem showed the small intestines to be greatly darkened and inflamed. The lungs presented localized areas of congestion. The kidneys were enlarged and anemic and the spleen dark and swollen. The specific organism was recovered in pure culture from the lungs, heart, and spleen.

Intraabdominal.—The second mouse was inoculated intraabdominally on July 30 with 0.1 c. c. of a culture (sixth generation) which had been originally obtained from the lung of guinea pig No. 798 on February 2 and had been subjected in the meantime to repeated transplanting on slant agar. On August 2 the mouse was dull and stupid, with hair ruffled, and it remained crouching under the cotton in its cage the entire day. These conditions were very manifest on the following day, and on August 4 purging was established, which also continued on the 5th. The mouse was very languid and quiet on August 6 and 7, and died on August 8, nine days after the inoculation.

On postmortem the heart, liver, and lungs appeared normal. The intestines were inflamed and empty. The spleen was light in color and somewhat swollen. The glands of the lymphatic system, especially those of the throat and neck, were enlarged and congested.

Ingestion.—Mouse No. 3 was fed for four days, beginning July 30, upon bread that had been moistened with 8 c. c. of a bouillon culture of the same description as that used in the preceding test. On August 7 the mouse began purging, which continued until August 9, when it died. The autopsy showed that the lesions were confined to the digestive organs, the heart and lungs appearing normal. Cultures of the micrococcus were recovered from the heart, liver, and kidneys of the two last-mentioned mice.

EXPERIMENTS ON RATS.

Both the white and brown rats appear to be totally immune, although submitted to subcutaneous and intraabdominal inoculations with 0.5 c. c. of fresh virulent cultures. They evinced no apparent disturbance of any of their organic functions.

Feeding experiments were likewise accompanied with negative results.

EXPERIMENTS ON GUINEA PIGS.

Guinea pigs have proved susceptible in every inoculatory case, and the course of the disease evinced by these animals is very typical. They show gradual emaciation and wasting, with symptoms of pneumonia appearing a few days previous to death. Numerous cases developed enteritis with its consequent purging, but this condition was by no means constant. Convulsions, which so frequently attack rabbits during the latter stage of this disease, were not at any time observed in the guinea pig. The peculiar form of pneumonia already noted as appearing in the goat is seen to affect the guinea pig with

great regularity. The organism was readily recovered from the heart, lungs, liver, kidneys, and spleen; in fact, it was found to be distributed throughout the blood of the circulation. Examinations of the flocculent sediment occasionally found in the urine resulted negatively.

A few typical cases of the disease in guinea pigs as a result of various forms of inoculation may be briefly given as follows:

Subcutaneous.—On January 3 guinea pig No. 707 received subcutaneously 0.25 c. c. of a bouillon culture of twenty-four hours' growth from the spleen of goat No. 2. The animal soon began to give evidence of an insidious disturbance of its nutrition, which continued until January 26, when it died, having in the meantime gradually reached a condition of extreme emaciation. The organism was recovered from the lungs, heart, spleen, and mesenteric glands. The period of life following the subcutaneous inoculation of doses ranging from 0.25 to 0.5 c. c. varied from sixteen to twenty-three days, and averaged twenty and one-half days.

Intramuscular.—On January 3 guinea pig No. 710 received 0.25 c. c. of the same culture used in the test with No. 707, injected intramuscularly. Eight days later, or on January 11, the animal died.

Postmortem examination showed the carcass seriously emaciated. Liver and spleen enlarged, lungs congested, and the kidneys pale and softened.

Intramuscular inoculations of from 0.25 c. c. to 0.75 c. c. of a twenty-four hour bouillon culture resulted in the death of the guinea pigs in from eight to thirteen days, with an average of nine days.

Intraabdominal.—Guinea pig No. 801 was inoculated intraabdominally on January 20 with 0.75 c. c. of a bouillon culture from the spleen of goat No. 2. Nine days later the animal died and the postmortem examination disclosed the usual picture of a wasted carcass, occluded lungs, inflamed intestines, fatty degeneration of the liver, and anemic kidneys. The average period of life following an injection of 0.25 to 0.75 c. c. by this method was twelve days, although death occurred in some cases as early as the eighth and as late as the twentieth day.

Ingestion.—After being deprived of food for twenty-four hours, guinea pigs Nos. 1413 and 1417 were fed 40 c. c. of a twenty-four-hour bouillon culture soaked in bread crumbs. No deleterious results were observed as a result of this feeding experiment.

EXPERIMENTS ON RABBITS.

These animals possessed a certain degree of immunity, many of those used in the various tests remaining unaffected. Those that became ill showed a marked rise of temperature, which diminished slowly after reaching its crisis, and for twenty-four hours preceding death was subnormal. Diarrhea and wasting uniformly appeared, and the subject frequently died in convulsions or tetanic spasms.

Intraabdominal.—The intraabdominal inoculation of 1 c. c. of a bouillon culture produced death in twenty-five days. The postmortem examination showed the lungs to be normal, the heart pale and flabby, liver enlarged and hyperemic, with gall bladder greatly distended. Spleen shrunken and showed excess of fibrous tissue. Intestines contained much gas and a small amount of fluid ingesta. The mucosa of the small intestines presented a catarrhal inflammation. Pure cultures were obtained from these affected organs.

Intratracheal.—Rabbits Nos. 382 and 383 were injected intratracheally with 1.5 and 1 c. c. of a bouillon culture, which resulted in death on the twenty-ninth and twenty-second day, respectively. Rabbits Nos. 381 and 472, each receiving 0.5 c. c., remained unaffected. The postmortem examination of No. 382 showed the mucous membrane of the trachea to be inflamed in patches, especially along the anterior portion. Both lungs were hepatized in numerous localized areas. Heart flabby, liver dark, and gall bladder filled with watery bile. Spleen indurated and reduced in size. Intestines catarrhal and empty. Bladder distended with albuminous urine.

On postmortem examination of rabbit No. 383 the hide was found to be very tightly attached to the subcutaneous tissue and extremely dry. The pharynx and trachea were inflamed throughout. Cephalic lobes of both lungs hepatized. The auricles were distended and the heart muscle pale. Spleen shrunken. Kidneys dry and flabby. Liver dark in color, with distended gall bladder. Intestinal contents fluid.

Culture media inoculations were positive in both the above cases.

Intravenous.—Rabbit No. 219 was inoculated intravenously on January 3 with 0.5 c. c. of bouillon culture from spleen of goat No. 2. It remained unaffected.

On January 15 rabbit No. 233 received 1 c. c. of the second generation of a bouillon culture obtained from the spleen of goat No. 2. On January 23 it refused to eat and on the following day it died in tetanic spasms. Microscopic and cultural examinations demonstrated the presence of the *Micrococcus caprinus* in the heart, lungs, and liver.

Ingestion.—After twenty-four hours' abstinence from food, rabbit No. 728 received the organism mixed in its food for two consecutive days, commencing on April 17. The animal remained unaffected for a period of three months, at which time it was withdrawn from the experiment.

Rabbit No. 296 was subjected to the same feeding test on April 17. On May 7 the rabbit seemed partially paralyzed in hind limbs; had fallen away greatly in flesh, and was a mere skeleton. May 8, hind limbs fully paralyzed. May 11, died after a period of twenty-five days.

Postmortem examination showed the animal to be very anemic and

emaciated. Lungs appeared reddened and filled with blood. Heart normal. Liver enlarged and greatly darkened with the gall bladder distended with bile. Spleen showed an apparent atrophy and dryness of the splenic pulp. Kidneys of normal size but pale in color. Bladder greatly distended and filled with albuminous urine. It was attached at its fundus to the cecum by frail bands of fibrous tissue. The ileum was likewise adherent to the parietal peritoneum and to the liver. The stomach contained normal food, but its mucosa was covered with a thick glutinous mucus. The stomach wall appeared tender and was readily torn. Its pyloric end and the beginning of the duodenum was greatly thickened and the mucosa inflamed and convoluted. Inflammatory mucus could also be observed throughout the entire extent of the small intestines. Cover-glass preparations from the juices of the liver and lungs showed the presence of the specific organism.

EXPERIMENTS WITH CHICKENS.

The inoculation of fowls proved that the micrococcus possessed purgative properties for these birds, but in no case was the result fatal.

Intravenous injections of 1 c. c. and subcutaneous inoculations of 3 c. c. were made on four chickens, with uniform results. On the day following the inoculation the fowls become dull and listless. On the second day they refuse their food and are affected with diarrhea, which may persist for forty-eight hours, but in no case under our observation did it last longer. Recovery of normal condition is rapid after cessation of the purging.

It may also be mentioned at this time that the carcasses of the goats having died of takosis on a Pennsylvania farm were fed by the owner to his chickens and swine, but in neither case was any unfavorable result observed.

EXPERIMENTS WITH DOGS.

These animals, like rats, appear to be totally immune to the action of the organism. They were subjected to intravenous inoculations of 0.75 c. c. of a fresh bouillon culture, but without developing any untoward results.

EXPERIMENTS WITH SHEEP.

Sheep have proved nearly as resistant as dogs. Two animals received intravenously and subcutaneously 1 and 2 c. c., respectively, of a twenty-four-hour bouillon culture. In the case of each sheep there was a temporary rise of temperature following the inoculation, which lasted about twenty-four hours. These animals were kept under careful surveillance for thirty-eight days, and during that time no after effect from the action of the organism was noted.

In connection with this experience it should be recalled that a num-

ber of Shropshire sheep were in immediate contact with the goats on the Pennsylvania farm where the disease was first observed. In no case have sheep contracted the disease by such exposure.

EXPERIMENTS WITH GOATS.

Nicole and Refik Bey, when writing of an infectious disease which was decimating the flocks of goats near Constantinople, said that, although the disease spread rapidly from goat to goat when the sick were pastured with healthy animals, they had found goats in the laboratory to be very resistant to all attempts at artificial inoculation. The results in the present instance warrant us in fully indorsing their conclusion regarding the resistant nature of goats, especially the common goat, when subjected to similar conditions.

The first goat upon which inoculation tests were made was a large aged male that had spent much of his life in harness in the vicinity of this city. He received intravenously 2 c. c. of a three-day-old bouillon culture on April 14, when his temperature was 102° F. There was no sudden marked change, but after several days 103.2° F. was recorded. The fever gradually subsided until normal was reached. No evidence of any effect from the inoculation, other than this rise of temperature, was noticed. On June 7 he was reinoculated intra-abdominally with 5 c. c. of bouillon culture obtained from the liver of a guinea pig which had died but three days previously. His temperature just previous to inoculation was 102° F., but it immediately rose until it reached 104.6° F. on the evening of the same day. On the following day 104° F. was recorded, 103.1° F. on the third day, and normal on the fourth. No indication of any other disturbance as a result of the inoculation was noticed at any time.

An aged female goat that had been previously kept in the city as a milk producer was inoculated intravenously with 5 c. c. of a bouillon culture (fourth generation) on June 20. Temperature at time of inoculation was 102° F. The first rise in temperature was noted on June 23, when 102.6° F. was recorded, with 103° F. on June 24. On the following day 103.4° F. was reached and the animal refused the greater part of its food. On June 26 inappetence continued and purging began, while the temperature dropped to 102.8° F. The following day, the seventh after inoculation, the patient was purging freely a quantity of slate-colored feces. Temperature, 102.2° F. On the 28th, although the excreta were still soft and whitish in color, there was no distress from diarrhœa. The animal still refused food. On the following day, the ninth of the test, the appetite began to return, and the goat soon recovered its normal condition.

On July 10 goat No. 14, a small mature female, received intra-abdominally 4 c. c. of a bouillon culture obtained from the heart of a guinea pig. During the four days following the inoculation the goat

neither ate nor drank. The maximum temperature was reached on July 16, when it registered 103.8° F. On July 24 diarrhea, with whitish mucous discharge, developed, which persisted for seven days, during which period the patient's appetite was again greatly impaired and capricious. The condition and strength of the animal rapidly wasted away. She remained incumbent much of the time, and when obliged to move walked with a staggering gait. Her illness was so serious at the crisis of the attack that her ultimate recovery was a matter of great surprise to those who were caring for her. Her convalescence was rapid as soon as the diarrhea was overcome, and she soon began to eat well and to make daily improvement in flesh and spirit.

Goat No. 15, a young native female, was fed 200 c. c. of a bouillon culture on July 23 and a like amount on the day following. Aside from a transitory rise in temperature of 1.4° F., there was no result apparent.

Another experiment was made on a grade Angora goat, No. 1741, the subject being a young female which received intraabdominally, on October 2, 1 c. c. of a bouillon culture from guinea pig No. 1140, which was inoculated with goat bouillon culture. Her temperature reached its highest elevation on October 8, when it registered 104.5° F., and no material change was noted until the decline developed about twenty-four hours before death. October 10 the subject became dull and inactive and diarrhea began to make itself manifest. On the following day violent purging had become established, the feces being thin, watery, and nearly white in color, the animal at this time appearing noticeably shrunken and weakened. On October 12 the purging still continued and the subject began to manifest extreme weakness. On the morning of the following day, the eleventh day of the test, the animal died. No indications of any respiratory disturbance were evidenced at any time during the course of the disease, although the lungs were found to be affected at autopsy. On post mortem examination the carcass showed great emaciation of the muscular tissues, which appeared whitened and bloodless. The mucous membranes were anemic. The heart was seen to be pale, with a few slight petechial hemorrhages beneath the epicardium around the superior border of the ventricles. Pulsations had stopped during diastole, leaving the ventricles filled with blood. The lungs showed a moderate attack of the characteristic pneumonia. The liver appeared darkened, in color, while the gall bladder was distended to the size of a man's fist. The fluid which caused this distension lacked the oily viscid characteristics of normal bile, but appeared like water of a greenish color.

The spleen of this animal was pale and shrunken to about one-half of its normal size. The kidneys were softened and anemic and the bladder contained albuminous urine. Rumen, reticulum, and omasum

were, with their contents, in normal condition, but the mucosa of the abomasum showed a slight congestion, and a mucoid exudate was found to cover its entire internal surface. No food was found in the fourth stomach, its contents consisting of liquid only. A like congestion and slimy exudate were seen to extend through the duodenum. The large intestines were bloodless and empty, but the lymphatic glands of this region appeared slightly hemorrhagic. The blood vessels of the brain were somewhat congested, while the spinal cord presented nothing abnormal.

At the beginning of this experiment the weight of the goat was 45 pounds. Weighed again immediately after death, it was shown that there had been a loss of 7½ pounds during the course of the disease.

Pure cultures of the specific micrococcus were recovered from the tissues of this animal.

PRODUCTION OF TOXINS.

In order to ascertain if the micrococcus under consideration produced a toxin, a number of inoculation experiments were made both with the sterile filtrate of bouillon cultures and with the sterilized cultures.

The filtrates used in this experiment were obtained by growing a flask of bouillon culture for ten days at a temperature of 37° C. Afterwards the culture was filtered through a Chamberland filter (F), and, if proved sterile by media inoculations, the filtrate was then ready for use.

Four guinea pigs were used, each receiving the filtrate subcutaneously. No. 1151 received 1 c. c. of the filtrate February 25, but because of an accident it was necessary to remove the animal from the experiment before the test was completed. No. 1152 received 1.5 c. c. of the filtrate February 25, and seventeen days later, March 14, an inoculation of 0.5 c. c. of a virulent culture was injected. The guinea pig remained active and hearty, save for a temporary disturbance following the inoculation on February 25, until October 16, when it suddenly succumbed to an attack of pneumonia. The carcass was not emaciated, but, on the contrary, was well supplied with fat. Cultures made from the various organs failed to produce the *Micrococcus caprinus*.

No. 1153 received 2 c. c. of the filtrate on February 25, and seven days later 0.5 c. c. of a virulent culture, which was followed by a reinoculation of 0.5 c. c. of virulent culture ten days afterwards. Shortly after the application of the first inoculation of filtrate the animal was affected by dullness and loss of appetite, but after three days these symptoms disappeared, and the animal recovered its previous condition of perfect health, which it retained until October 18, when it died of enteric hemorrhage. The carcass of this animal was

well nourished and showed no traces of wasting or emaciation. The lungs contained numerous circumscribed pigment areas, the remains of former hemorrhagic infarcts. As two hundred and twenty-eight days had elapsed since the animal received its first inoculation with a virulent culture of the *Micrococcus caprinus*, it was, of course, impossible to establish an undisputable relation between the lesions of the lungs and the action of this germ, but it is not at all impossible that these ecchymosed areas were former centers of inflammation resulting from the inoculation of March 14. Cultures made from the organs of this guinea pig gave negative results.

No. 1154 was inoculated with 3 c. c. of filtrate on February 25, which was followed by a rise of temperature and slight indisposition. Seven days later 0.5 c. c. of a virulent culture was injected, and ten days subsequently 2 c. c. of the filtrate. The general appearance of this animal for six weeks following its inoculation with virulent culture showed nothing amiss, but during the latter days of April it became affected with lameness in all its feet. Fissures gradually developed on the plantar surface of each foot, and the inflammation later extended to the joints of the legs. This condition continued to become more aggravated until the animal died, on May 12. In addition to the lesions of the legs and feet, there was a slight dropsical effusion within the abdominal cavity at the time of holding the autopsy, but cultures obtained from the tissues failed to show the micrococcus under consideration.

The effect of heat upon the toxins was obtained by heating the filtrate for thirty minutes at 60° C. Four guinea pigs were then inoculated, respectively, with 1, 2, 3, and 4 c. c. of this material, at the same time that four others received the same quantity of the filtrate which had not been subjected to such heating. Three days later these eight animals, together with two control guinea pigs, were inoculated intra-abdominally with 0.5 c. c. of virulent culture. The four guinea pigs receiving, respectively, 1, 2, 3, and 4 c. c of the heated filtrate died in twenty-one, sixteen, nine, and twelve days, respectively, after the injection of the virulent culture, while the check animals lived for nine and thirteen days. Three of those guinea pigs that received the unheated filtrate are at present writing in an apparently healthy condition, while guinea pig No. 2832, that was inoculated with 1 c. c. of the filtrate and three days later 0.5 c. c. of a virulent bouillon culture, died of typical takosis on the seventeenth day.

It appears from these experiments that the unheated filtrate possessed bactericidal properties and conferred limited power to prevent an attack of takosis, but when subjected to a temperature of 60° C. for thirty minutes its toxin was presumably destroyed, as no protective action was observed following its use.

In order to test further (see also remarks on treatment, p. 42) the immunizing effect produced by the administration of the toxins

in the filtrate, 5 c. c. of this fluid were injected subcutaneously on September 18 into each of four goats, two being affected with scours and greatly enfeebled, and two healthy animals, Nos. 1936 and 721. The first two died within forty-eight hours, as was expected, but the latter two are still healthy. The extent of immunity conferred by this filtrate was the subject of further consideration, and for this purpose goat No. 1936 alone was used. The animal was a young female Angora goat weighing 48 pounds and received intravenously, on October 2, 1 c. c. of a bouillon culture prepared from the heart of a guinea pig that had died from a culture of goat spleen. At that time her temperature was 102.4° F. An elevation was noted on October 6, when 103.5° was recorded; on the 8th, 104°; and on the 10th, 105.2°, at which time purging became established. On October 11 the animal refused food, was unwilling to stand, and was purging freely, the feces being very light in color and covered with mucus. October 12, still purging; feces nearly white; temperature 104.2°. October 14, feces firmer, but still white; temperature normal; weight, 44 pounds; appetite improving; circulation of extremities impaired to such an extent that they feel cold to the touch; normal conditions quickly returned after this time. After an interval of twenty-five days from the time of first injection another inoculation was made with 2 c. c. of a virulent culture intraabdominally, since this method has always shown more positive results. In this instance the goat became dull and languid, which conditions, however, quickly passed away, and her temperature never exceeded 102.4° F.

That the immunity was conferred by the 5 c. c. of filtrate received on September 18 must appear evident when taken in connection with the results obtained with the check animal, goat No. 1741 (see p. 24), which died eleven days after the inoculation with a similar culture. After one month had elapsed from the date of the complete recovery goat No. 1936 was bled aseptically, and the sterile serum procured for further experimentation. Five guinea pigs were inoculated, respectively, with 1, 1.5, 2, 2.5, and 3 c. c., and three days subsequently received 0.5, 0.25, 0.75, 0.50, and 0.30 c. c., respectively, of virulent culture, which killed the check guinea pig in eleven days after an intraabdominal injection. At the present time three of these guinea pigs show no inconvenience as a result of the inoculation, while the third and fifth guinea pigs, that received 0.75 and 0.3 c. c. of the culture, died on the forty-first and thirty-ninth day, respectively, the latter with takosis and the former of an intercurrent disease.

It will be seen at once that the immunizing properties of blood serum obtained from an immune goat were not perfect in their action when applied to the guinea pigs in this test, although the protection of three of the animals (Nos. 1, 2, and 4) offers sufficient encouragement to warrant further investigation along this line. Had the pro-

tective powers of the serum been theoretically effective, the guinea pig that died with takosis (the fifth of the test group) would have been the last one of the number to show the effects of the disease, as it received the largest amount of the serum and one of the smallest amounts of the virulent culture. Comparison of the duration of the affection in the case of the guinea pig that died of takosis thirty-nine days after the virulent culture was applied, with its course of only eleven days in the animal used as a check, indicated further that the serum exerted some retarding action upon the advance of the disease in this animal. This same serum has been subjected to a practical test on twenty goats in a flock of two hundred and fifty in which the disease is now prevailing. The results of the above treatment can not be obtained in time for this publication. The test with blood serum as an immunizing agent against takosis is at present too incomplete to warrant any accurate estimate of its protective value, and, although the few experiments herein recorded show encouraging results, the immunity has not yet been proved sufficiently constant or reliable to justify at present a recommendation of serum for general use as a protective agent.

After observing the apparent bactericidal properties possessed by the filtrate it was decided to ascertain the effect of the sterilized bouillon cultures. These were prepared by growing the culture for ten days in 5 per cent glycerinized peptone bouillon, then killing it by an exposure of thirty minutes to 60° C., and afterwards filtering through sterilized cotton. From this study it would appear that the toxins are extracellular and that they are destroyed by the above temperature, as the injection of this fluid failed to produce the least reaction in the inoculated guinea pigs; nor were the guinea pigs protected in the slightest degree from a subsequent inoculation of a pure culture, as will be seen from the following:

Six guinea pigs inoculated on November 7 with the sterilized cultures in doses ranging from 1 to 3 c. c. subsequently received, subcutaneously, 0.5 c. c. of a virulent culture simultaneously with two check animals. Deaths followed among the first group of animals on an average of sixteen days, while the two control animals died on the fourteenth and eighteenth days, respectively. Inoculation experiments were begun at the same time on a small flock of goats, each animal receiving 3 c. c. subcutaneously, which was repeated in ten days. The preliminary report in this instance confirms the work done on guinea pigs, and shows rather conclusively that the immunizing properties of sterilized cultures are practically nil.

MICROSCOPIC LESIONS.

Lungs.—Microscopically, the terminal bronchioles and alveolar passages present swollen walls and contain various amounts of mucous

exudate and desquamated cells as a result of a catarrhal inflammation. In most cases where the diseased areas in the lungs of the goat were examined there has been found little pneumonic consolidation, but bronchiolitis is quite prominent. Some small areas of consolidation are seen with the alveoli and air sacs filled with granular debris and variable numbers of epithelial cells, red-blood corpuscles, and leucocytes. An active desquamation and proliferation of the epithelial lining membrane is present. The interalveolar septa show a considerable round cell infiltration. The blood vessels of the septa are distended and surrounded by migrated leucocytes. Frequently a bronchus is found affected, with the lumen containing a small number of desquamated epithelial cells and slight fibrinous exudate and leucocytes. A round cell infiltration is seen in the neighborhood of the bronchus, the walls of which are swollen, indurated, and granular in appearance. The surrounding peribronchial tissue shows in most cases an inflammation by contiguity. The pulmonary lesions observed in the guinea pig present the characteristics of a bronchopneumonia. The organism is occasionally found in the fibrinous exudate and in the blood vessels.

Liver.—In the liver of the guinea pig there appears to be a congestion of the blood vessels, especially in the portion lying beneath the capsule, and is accompanied by focal areas of fatty degeneration occupying the peripheral zone of the acini in the form of numerous small globules, which in some cells completely obscure the nucleus. The protoplasm of the hepatic cells is extremely granular. In the organ obtained from the goat there is no congestion, but the areas of fatty degeneration are observable, although in a small degree, and always in insular patches.

Kidneys.—The kidneys present the microscopic appearance usually observed in catarrhal or parenchymatous nephritis, with the most marked changes occurring in the cortex. Certain Malpighian tufts show an increase of cells due to the proliferation of the vascular epithelium, obscuring and compressing the capillaries. Increase of the cells of the tufts sometimes occurs. The intercapsular space is dilated and contains an albuminous exudate. The convoluted tubules show the epithelium to be swollen and granular, and in some cases desquamated, while the lumina of these tubules also show the presence of an albuminous deposit. As the micrococcus has not been found in the kidney on microscopic examination, the lesions here are presumably the result of the toxins.

Heart.—Localized areas of parenchymatous degeneration may be observed, involving isolated fibers or groups of fibers. Their contents are found to be fine granules of an albuminous nature, which do not completely obscure the striations or the nuclei of the muscle. In some fibers a more advanced stage has occurred, which results in the production of small, dark granules, accompanied with small droplets

of fat. In the heart of the guinea pig the interfibrillar connective tissue shows a proliferation of the nuclei, and there is a slight indication of a round cell infiltration.

Spleen.—A microscopical examination shows a thickened capsule, which is wrinkled and contracted. An increase in the thickness of the fibrous trabeculæ proceeding from the deeper layer of the capsule and from the walls of the small blood vessels is the conspicuous feature, with the accompanying atrophy of the Malpighian corpuscles and splenic pulp. The connective tissue cells and delicate strands of fibrillated tissue are very noticeable among the lymphoid elements.

Small intestines.—The appearance of these tissues, especially of the duodenum, is that of a productive inflammation with exudation, associated with more or less necrosis of the mucosa. The mucous membrane of the small intestine shows extensive desquamation of the epithelial lining and at times a superficial or even complete necrosis of the glandular layer. The mucosa may also present a typical productive inflammation with exudation of a fibrinous character and small cell infiltration around the engorged blood vessels. The solitary follicles are hyperplastic. The serous coat is thickened and the blood vessels visibly distended. Scattered profusely throughout the exudate and within the blood vessels of the submucosa, as well as in the intact mucosa, are the specific micrococci.

BLOOD EXAMINATION.

The attention of one who is called to examine a goat suffering with takosis is at once attracted by the anemic, bloodless appearance of all the exposed membranes. So prominent is this symptom that efforts have been made to determine the effect of the disease upon the blood. The germ (*Micrococcus caprinus*) is readily recovered from the blood of the circulation in any part of the body of animals that have died as a result of the test inoculations or of the natural disease. It is found in the plasma, but never within the cells themselves. Ellenberger (Physiologie der Haussäugethiere) and R. Meade Smith (Physiology of Domestic Animals) give the number of red corpuscles in a cubic millimeter of normal goat blood as varying from 9,000,000 to 10,000,000. A count was made from the blood of several goats obtained for experimental purposes in the laboratory and the result was confirmatory of this statement in a very satisfactory degree. The average result of the count in these cases gave the number as 9,976,000 per cublic millimeter and about 9,200 leucocytes in the same amount of blood. Later a count was made from the blood of an Angora goat sent to the laboratory during the last stages of the disease.

The animal was greatly emaciated, of an anemic, debilitated appearance, and was suffering from profuse diarrhea. We have no means of knowing how long this goat had been affected by the disease, but

evidently it had been ailing for some weeks. The count of red corpuscles in this instance gave 11,208,000, showing a material increase above the normal number. Other counts were made from the blood of two Angora goats that had been received at the laboratory in a healthy condition and afterwards inoculated with *Micrococcus caprinus*, one receiving 1.5 c. c. of a bouillon culture intravenously and the other 1 c. c. intraabdominally. Violent purging ensued in eight days in both cases. The count of the corpuscles of the blood was made before the animals recovered fully from the effects of their inoculation and when the purging was quite profuse. The result obtained by counting the corpuscles under these conditions was that the blood in the first contained 11,190,000 red-blood cells and 20,560 white cells per cubic millimeter, while in the second case the red and white cells numbered 12,160,000 and 18,420, respectively. The leucocytosis in these instances was chiefly due to an increase in the number of polymorphonuclear leucocytes and the eosinophiles. In another case affected with the natural disease the red corpuscles numbered 10,208,000 and the white corpuscles 14,860.

It will be seen from the few blood counts thus far made that the number of red corpuscles is not diminished; in fact, it is sometimes increased (polycythemia), especially during the presence of the diarrhea, and is probably only relative, coincident with the removal of the watery constituents of the blood. The individual red cells are small (normal size 4.1μ.—Ellenberger), pale, and light in weight, presumably the result of the loss of nitrogenous material. They are also changed in outline, particularly in the later stages of the disease, when they assume an irregular, misshapen form (poikilocytosis). The increase in the number of leucocytes (leucocytosis) is absolute and dependent upon the chronic nature of this infection. In explaining the phenomenon in this instance we are inclined to ignore the overproduction theory of Virchow and Ehrlich and accept the idea advanced by Von Limbeck, Jakob, and Goldschneider, who hold that the bacterial toxins circulating in the blood act in a chemotactic manner to attract into the blood stream leucocytes which were previously in the lymph channels and spleen, and that these white corpuscles added to those already in the blood produce the leucocytosis. The specific gravity of the blood was taken in a number of instances with the average record of 1.031. It is utterly impossible to determine the amount of hemoglobin present by means of the Von Fleischel instrument, as the greenish tint of the blood is not comparable to the red of the index glass. However, the amount of hemoglobin was relatively ascertained as 56 per cent by a modification from Schmaltz (Pathologie des Blutes und die Blutkrankheiten, Leipzig, 1896), considering the normal specific gravity of the blood of the goat as 1.042.

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TECHNIQUE.

For the histological study of the pathological alterations, the tissues were fixed in either Graf's chrome-oxalic fluid, Zenker's fluid, or gradually ascending strengths of alcohol and hardened in dilute chloroform. They were then infiltrated and embedded in paraffin and cut in serial sections. In bringing out the pathological lesions various staining preparations were employed, including hematoxylin and eosin, Weigert's fibrin stain, Bismarck brown and eosin, Gram's method followed by eosin, alum-carmin, and carbol-fuchsin counterstained with methylene blue, the best and most distinct sections resulting from the first two mentioned agents.

DESCRIPTION OF PREVIOUS EPIZOOTICS OF ALLIED CHARACTER AMONG GOATS.

The first mention in foreign literature of any disease of goats simulating the one now under consideration seems to have been made by Pusch (12),[a] of Dresden. The disease appeared in the fall of 1894 among a number of goats recently brought from the Simmenthal of Switzerland for breeding purposes. Upon their arrival in Saxony they were sold to different breeders and in this way were scattered about in six neighboring towns and upon thirty various farms. Several days later a disease appeared simultaneously among the goats of this importation in five of the six towns in which they had been received, and it quickly spread to the neighboring goats with which they had been placed.

The animals were purchased on October 8, and were unloaded from the cars and delivered to their several owners on October 12. Nothing was seen to be wrong with them at this time, but after a few days complaints began to reach the authorities which stated that the goats were affected with cough and diarrhea. They were visited by Dr. Pusch on October 25, thirteen days after their arrival from the south. On the first farm which he visited, he found three imported goats and one native goat sick. All of them coughed in response to percussion with a short, superficial, painful cough. The native goat seemed to be more seriously affected than those recently arrived from Switzerland. Its temperature was 40.5° C., respiration 35, and pulse 110; mucous membranes yellowish; nostrils widely distended; breathing labored and painful; appetite poor. The animal was so sluggish that she refused to stand. On another farm he found that one of the goats had been killed and its viscera buried. The heart and lungs were recovered and examined, but under the existing circumstances the results were not satisfactory. The heart was seen to be gray-red and very poor in fat. Pneumonia was present, accompanied with enteritis. Mice inoculated

[a] These figures refer to bibliography at end of this article.

from these lungs gave negative results. On this farm the disease spread among the native goats to a serious extent. The incubation period was about ten days. Sheep kept in the same pasture were not affected. The greater part of the imported goats sickened after their arrival, and, as they were all bought in the Simmenthal and were not unloaded en route, infection during transportation was impossible. The disease appeared simultaneously among most of the goats of this importation, and quickly spread to the natives with which they had been herded, causing great loss among the latter animals.

The infected farms were quarantined until the diseased animals had either died or recovered, which required but a few months, as the affection disappeared voluntarily during that time.

Another outbreak of a very similar disease among goats was reported by Storch (14).

The native goats of Schmalkalden are of large size, rugged, good producers of milk, and, until the importation of Saanen goats from Switzerland, they were very healthy.

Twenty Saanen goats were imported and placed among the native flocks in May, 1894. In July the disease had become so widely spread that the authorities sent Schutz and Storch to investigate. Storch states that the report of Pusch, 1894, is the only one in German literature describing a disease which resembles this in any way, while Hutcheon's pleuro-pneumonia of goats in South Africa may be the same thing, but he is unwilling to decide.

Of 620 goats in Steinbach-Hallenburg 331 became affected, and many of these died, but no accurate statement of the number of deaths was obtainable. In the acute form the goats refuse food, become dull and depressed, and lie down most of the time. Their breathing becomes labored and painful; pulse often reaches 120 to 140 per minute; cough is always present. About one-half of these cases are fatal, many of the animals dying in convulsions and opisthotonos.

In the chronic form, a cough is always present, frequently accompanied by nasal discharge. The disease is lingering and persistent, but apparently does not affect the appetite.

Examination of the lungs showed collapsed areas in one or both anterior lobes. Mucous membranes of the bronchi were reddened, thickened, and covered by a slimy coating. Bacteriological examination revealed the presence in the lungs of numerous oval to round bacteria, frequently in pairs, but occasionally single, while the blood, spleen, and liver proved negative. White mice inoculated subcutaneously with cultures showed a staring coat and dullness, but recovered. A rabbit two months old, inoculated with scrapings from a diseased lung, died atypically in three days. Hepatized areas had developed

in its lungs, however, and the presence of the organism in these tissues was established.

Healthy goats placed in isolated stalls in stables sheltering diseased animals became infected.

Susceptibility appeared to increase with age, since young kids were not affected. Mortality of the acute and chronic forms considered together reached about 25 per cent.

Careful inquiry failed to give any trace of a similar disease in the Simmenthal where these goats were purchased. Further importations of goats into the Kingdom of Saxony were prohibited at once as a result of this outbreak.

Various experiments were made in the matter of treatment, but the best results were derived from the inhalation of creolin.

Nicole and Refik Bey (10), of Constantinople, describe a pneumonia among the goats of the region adjacent to the Gulf of Ismid, it having been brought there by goats purchased in the interior of the country.

The symptoms were first fever, then loss of appetite, cough and nasal discharge, disturbed breathing, and soon the animal began to lag behind the flock, appearing dull and languid. The disease lasts a long time and the animals become somewhat paralyzed four or five days before death. The attack is not commonly accompanied by enteritis. Calves and sheep kept in the same flock were not affected. Microscopic examination showed red and gray hepatization, and the vessels filled with leucocytes. The pleura was thickened, and exudation into the pleural cavity was moderately abundant.

They have constantly isolated a cocco-bacillus from the lungs. It is sometimes alone and sometimes in association with the colon bacillus or with *Bacillus pyocyaneus*. It was never found in the blood. It seems both by its form and character to belong to the hemorrhagic septicemia group. The bacillus does not retain its stain when treated by Gram's method. On liquid media it appears sometimes as a diplococcus, and again as a lance-shaped bacillus, resembling in its contour and size the pneumococcus of Talamon-Fraenkel. When the nutriment in the media is abundant, its form is round and there is a decided tendency to form chains. Mice were most susceptible to this germ. A very small quantity of culture injected subcutaneously caused death in ten to twelve hours from septicemia. Two cubic centimeters subcutaneously kills rabbits in eight days, forming abscesses in the lungs. A test goat died in four weeks, emaciated, and with limbs paralyzed during the last few days of life. Cocco-bacilli were recovered from all visceral organs. Another goat recovered. A third goat showed diarrhea and fever the day after being inoculated and then recovered. It was subsequently reinoculated with fluid from a hepatized lung and died in one month. All goats tested in the

laboratory proved very resistant. Calves and dogs were inoculated with 5 c. c. of a pure culture without results.

The men who were first interested in introducing well-bred Angora, Thibet, and Cashmere goats into this country encountered some thoroughly discouraging experiences, which were very probably due in a measure to the ravages of the disease under consideration. As early as the year 1854 a prospective purchaser of Thibet goats living in the State of Georgia was warned by a naturalist of note against completing his purchase for the reason that these goats, "like the llamas of the Andes, could not be successfully acclimated in a locality under 10,000 feet above the ocean." The purchase was consummated in spite of the friendly warning of the naturalist, and the final owner (2), in recounting his experiences later, wrote: "His opinion proved to be correct, as all of the Thibet goats, pure and grades, in my flock died in a few years after I had purchased them, from a disease of their lungs combined with dysentery."

A writer (1) in the Country Gentleman of February 4, 1875, also reports serious losses in a flock placed in his care on a farm at Rapidan, Va. Although he records no specific symptoms, the following quotations have great interest to all who are making a study of takosis:

> In the early cold weather the goats began to sicken. I had the sick ones removed to other quarters, and wrote for remedies to Mr. E. I studied Randall also, but nothing cured them. They died, and more were taken sick. I sent for Mr. E., the owner of the goats, and when he came he said the difficulty was cold and hunger, though they had more than a "little hay and fodder" besides additional meal, much more in proportion than my sheep, which at that time were running at large without shelter and doing well. * * * The next morning a fine young buck which had been apparently well the night before was brought out in a dying condition. Mr. E. examined it closely and said it was a decided case of liver disease, an infectious epidemic which Angora goats were subject to in their own country, and regarded as so fatal by the Turkish shepherds that they said of it, "There is no cure but Allah."

Pegler (11) in the year 1885 described what he termed "A disease peculiar to goats." It will be seen upon reading the following excerpt from his work that his description of the scourge that appeared among the members of his flock might, in most particulars, very well be applied to a flock affected with takosis. From the page describing symptoms were borrowed the following:

> The first thing that is noticed is a falling off of appetite, which may at first be slight, but soon gets worse until it is a difficult matter to get the animal to eat at all. The result, of course, is that it rapidly loses flesh and falls away to a skeleton. Sometimes, however, the appetite remains good, but the emaciation goes on just the same, though the process is slower. The breathing is sometimes labored and the breath nearly always very unpleasant. A cough is very often an accompaniment of the disease, leading one to suppose, with other symptoms, that the lungs were affected, but this is seldom the case. The one prevailing feature which can never be overlooked is the general bloodlessness of the animal. This is shown by the pale color of the gums and inner surface of the lips, and also of the membranes lining the eyelids, which in health are of a bright red.

Before the disease is far advanced diarrhea sets in, which begins with a slackness of the bowels. This soon gets worse, however, and, though it may be stopped for a time, it is almost sure to break out again, owing to the failure of the digestive organs from the impoverished condition of the animal. The diarrhea may last for several weeks, but as it advances it often takes the form of dysentery. The poor creature then becomes too weak to stand, and it generally dies uttering plaintive cries and moans. There are other symptoms which occasionally manifest themselves, such as swelling beneath the jaws and weakness about the limbs, the animal always standing with its head down and back arched, looking the picture of misery and dejection.

Strange to say, in nearly all the postmortems which have been made and reported to me, there has been no organic disease. Internal parasites are sometimes discovered, but not in sufficient quantities to greatly affect the animal's health, much less cause its death, which in all cases is due to exhaustion.

ECONOMIC IMPORTANCE.

A few years ago the flocks of Angora goats in this country were comparatively unimportant in number, and they were nearly all of them kept in southern latitudes, but during recent years the raising of these animals has received a remarkable impetus. New uses have been discovered for the fleece, they have been widely exploited as brush eradicators, and their flesh has been more readily accepted as a food product, until at present they have reached an established, settled value in many of the larger live-stock markets. As a result of the widespread interest thus awakened in them, many stock raisers have made purchases of foundation stock with the intention of establishing therewith a profitable flock. Others have made larger purchases at the start, being unwilling to wait for the slow natural increase in numbers of their animals. By means of numerous transactions the animals have been placed in widely distributed northern localities to which they were formerly strangers, but the serious losses caused to these investors by outbreaks of takosis served as a check to many prospective purchasers, and the Angora goat industry was, in consequence, subjected to a discouraging setback, and has not expanded to the proportions which it would otherwise have reached.

Now that the cause of the trouble has been determined, one may be warranted in claiming that the disastrous effects of all outbreaks up to the present time may in the future be avoided in large measure. The owner of the flock of goats will now see the importance of deciding upon the nature of the ailment affecting them just as soon as any general disease is noticed; and when takosis has appeared and been identified, if he will at once apply the precautionary measures and the course of treatment to be recommended later in this work, he should avoid many of the discouraging experiences of his predecessors.

As has already been stated in this article, the most serious losses that have come to our notice have occurred among goats that were removed from southern localities to new regions far to northward, and that had not become fully acclimated in their new surroundings. In many

instances the trouble has appeared very soon after the arrival of the animals at their destination, even before they have recovered fully from the serious strain incident to the long journey by rail.

There is always a value to be derived from the confirmatory statements of many witnesses. Various observers are sure to offer a variety of observations upon any subject in which they may have a common interest, and for the purpose of presenting to the reader as generalized a knowledge as possible of the effects of takosis upon a flock of goats, and also for showing how diversified is the territory in which the ravages of the disease are being felt, it has been deemed advisible to present the following extracts received by this Bureau with reference to the disease.

From Knapp, Wis., the following was received:

I have in my charge about five hundred goats, and they have been dying from what I called stomach worms; but of late I have come to the conclusion that something else is the matter with them. They lose their appetite, grow thin in flesh, cough and get weak, and then lie down and die. Some linger along two or three months. There is from one to five in the flock that show the symptoms all the time, and from one to two die per week. They first cough, then lag behind the flock at night when coming to the barn. Then there is lack of appetite, they grow poor and weak and look gaunt all the time as though they have been starved

A letter of inquiry from Pittsburg, Pa., asks:

Would some of you let me know what the proper feed is for goats through the winter when they have no pasture? I bought a few Angora goats and so did a few of my neighbors, and they are dying. The flock that we obtained them from was very poor; in fact, I never saw anything poorer to live than the goats were when we received them. I feed mine on corn and oat chop, half and half, and corn fodder, and cut some apple brush, but for all I would do my goats died with scours.

A writer from Langhorne, Pa., sends the following record of his observations:

To look at our goats in the yard you would say they looked fine, and you could hardly pick out one that you might think was not quite up to the average, yet to-morrow morning you would find four or five down on their sides or otherwise. If picked up they might move off slowly and eat a little, but the next morning they would be down again. The animals will not get up or stay up, but will linger in this manner for some days, smelling badly and bleating occasionally or groaning, with head bent around on side or under them, and finally die. Sometimes, as a result of lying so long, they get apparently choleraic discharges from the bowels, which is offensive, but this does not show at first, and is not the primal cause.

Tioga County, Pa., has for several years had a flock of Angora goats, representing among its members some excellent specimens of the breed. The owner of this flock, in describing the course of takosis, writes:

None of the diseased goats recovered. It took a long time for many of them to die. They tried very hard to live, and some of them succeeded in living for weeks, only getting weaker and weaker and finally just fading away. Some had diarrhea but many did not.

In making a report of postmortem findings, a correspondent from Iowa mentions one of the characteristic symptoms of takosis as follows:

> The amount of bile is from one-fourth to three-fourths of a pint in each goat. A healthy goat only has, as I find, about a tablespoonful. This goat has been ailing for two weeks, but only refused to eat for two days. I have lost one-third of my flock and have not been able to save even one goat that has become sick.

A breeder in western Illinois states that he has lost one hundred out of a flock of four hundred, and that two of his neighbors have suffered proportionate losses. These goats were all well sheltered. He considers the disease some sort of cholera, reasoning from the fact that the animals were all affected with diarrhea.

The following extracts, from a letter received just as this paper was ready for the press, from the owner of a large flock of Angora goats in Michigan, confirm several of the statements made in the introduction of this article:

> We personally suffered a loss last winter in animals that we had brought from Texas in November, 1901, from this disease, and thus learned of the trouble. * * *
>
> We gathered together a herd of all grades of goats for the purpose of studying them and finally arrived at the conclusion that, so far as the Angora goat is concerned, the animal most susceptible to the disease, was the result of careless breeding, or to be more exact, too much inbreeding, thus lowering its vitality and leaving it open to the attack. * * *
>
> The care, feed, and shelter of the various grades of animals we have had was all alike, and it resulted, as stated, in the survival of the carefully bred, free from inbreeding Angora goat.

Other reports of like nature have been received from goat owners in Oregon, Missouri, Massachusetts, Virginia, and Maryland, all describing the affection as an incurable weakening and wasting away, usually accompanied by uncontrollable diarrhea and occasionally cough. The death rate has been very high in the flocks from which reports have been obtained and ranges from 30 to 85 per cent.

Another feature of takosis, which is of great economic importance to the breeder of goats, is experienced in the unavoidable tendency to abortion which is manifested by all pregnant females that are affected with the disease. Females of the sheep and goat families will never reproduce in a prolific manner if in a wasted, emaciated condition during the breeding season. Many of them will fail to come in heat, and others, although passing through the period of estrum normally, will fail to conceive. Takosis is essentially a wasting disease, and one of the marked results of its attack upon a flock of breeding goats is seen in the shrunken kid crop of the following season.

It is rare indeed for a pregnant doe to complete her term of gestation if attacked during this period by takosis. Abortion follows almost invariably. As might naturally be expected, the accident of abortion under these circumstances always ends fatally, as the animal is unable, in her already weakened condition, to withstand the shock

incident to delivery. Many times the fetus dies in utero, and thus becoming a foreign body to the maternal organism, it but hastens the eventual collapse of the doe. In holding autopsies on the bodies of affected pregnant does, it has been occasionally noted that the death of the fetus preceded that of the mother by a few days, and the fetal decomposition present has indicated that it played a prominent part in causing the death of the adult.

One flock has been brought to our notice which contained about 1,600 does at the commencement of the breeding season in the fall of 1901. They were seriously affected with takosis at this time, and in consequence there were but seventeen living kids produced in the following spring.

Another instance is reported where the total increase of a flock of over 1,000 does for the year was limited to eleven living kids.

DIFFERENTIAL DIAGNOSIS.

PARASITISM.

The condition which will most frequently be mistaken for takosis in goats is parasitism. In common with sheep, goats serve as hosts for a formidable array of animal parasites, and the loss directly or indirectly due to parasitic invasions must annually serve as a serious tax upon the goat raisers of the country.

The effects of internal parasites upon the goats are very similar in many of their outward manifestations to the symptoms of takosis. There is a persistent unthriftiness, although the appetite of the animal remains good. The fleece does not retain its proper luster. There may be considerable snuffling of the nose, accompanied by frequent coughing. The animal may become affected with diarrhea, more or less severe, and its accompanying weakness. The eyes lose their brilliance and gradually assume a dull sunken appearance. The formation of an edematous tumor beneath the jaws is frequently noticed during the later stages of a serious invasion. These, in a general way, are the symptoms resulting from an attack by animal parasites, but it must be remembered that there are species of worms that find their natural habitat in some particular organ, and that, in consequence, it is impossible to give an accurate enumeration of the symptoms that may be manifested in any given case under the general heading of parasitism.

The symptoms produced by the local disturbance of the affected part will predominate, while others, frequently caused by parasitic invasion, will be entirely lacking. Careful postmortem examination will quickly disclose the presence of parasites. A differential diagnosis previous to death of the animal may, however, be made by giving due consideration to the various symptoms manifested by these

diseases. First of all, the infectious nature of takosis, when compared with the enzootic course of a parasitic invasion, will justify one in making a definite diagnosis. In attacks of takosis, symptoms of pneumonia will be frequently noted, especially labored breathing or rapid respiration. These symptoms are not diagnostic of parasitism. The edematous lump under the jaw, so frequently present in cases of parasitism, fails in takosis. The luster of the fleece is less affected in takosis, while diarrhea is more frequently noted. Continuous coughing and snuffling, while diagnostic of the presence of lungworms, are not characteristic of takosis and are noted only occasionally in cases of this disease, unless there is a complication with some other affection.

ANEMIA.

In goats this is very rare, and when it does occur it is usually secondary to some previously existing disease, such as chronic pneumonia, peritonitis, or to poor food and starvation. It does not assume an infectious nature, and may be differentiated from the anemic condition accompanying takosis by the absence of the specific organism on microscopic examination.

WATERY CACHEXIA, OR HYDREMIA.

This usually results from poor feeding, innutritious food, or pasturing on low ground. The natural goat pasture is high dry land. The animal is weak, readily exhausted, breathes rapidly, and its heart palpitates. The mucous membranes of the eyes, nose, and mouth are pale and swollen. The edema which is present about the head, neck, and abdomen will serve to differentiate this disease from takosis. This edema of the head disappears when the animal lies down. Icterus may accompany the disease when the discoloration of the mucous membrane easily establishes the nature of the affection. A change of pasture and a more nutritious diet are accompanied by a return of health to the flock.

CONTAGIOUS PNEUMONIA.

There have been several instances recorded in which flocks of goats have been affected with a contagious pneumonia.

Hutcheon (6) has met with this epidemic in South Africa; Steel (13) has seen it in East India; and it has also been brought to the attention of French (3 and 8) and Italian (9) veterinarians.

Soon after the outbreak of this disease in the flock many of the animals will become affected with a cough. The temperature rapidly rises until occasionally as high as 107° F. is recorded. The appetite becomes disturbed or disappears altogether, and there is slight nasal discharge. The conjunctiva appears brownish or bronzed, the vesicular murmur of the lungs becomes modified, the pulse quickened, and the

breathing accelerated, labored, and painful. The affected animals always evince pain when pressure is applied between their ribs.

The postmortem examination of these cases shows the lesions to be chiefly confined to the thoracic cavity. The visceral pleura is usually adherent to the thoracic walls. The diseased lung is solidified and enlarged throughout one-half to three-fourths of its substance. It is covered with a firm elastic fibrinous membrane.

Respecting the nature of the disease, Dr. Hutcheon writes:

> It was a specific infectious form of pleuro-pneumonia, affecting goats only, cattle and sheep remaining free from infection, although constantly exposed to it. The disease was introduced into the Cape Colony by a shipment of Angora goats from Asia Minor, where the disease is represented as being indigenous.

At the present time contagious bovine pleuro-pneumonia has no existence among the flocks or herds of America, but since the goats of other countries have been proved susceptible to an analogous disease, the above mention of its leading characteristics may not be out of place.

TREATMENT.

PROPHYLAXIS.

In the study of takosis four points have been brought prominently into view which may properly be grouped together when considering measures for the prevention of the disease. It has been shown that the most destructive outbreaks have occurred among the goats that just previously have been shipped from a southern locality to a more northern latitude, and this fact suggests the need of caution in the removal of animals in this direction. Sudden climatic changes should be avoided so far as possible, and when shipments of goats for breeding purposes are to be made which necessitate their transportation northward over considerable distances the changes should be made during the months of summer or late spring, and not in the fall or winter, when the contrast of temperature will be so much greater.

Earlier writers have called attention to the fact that Angora goats do not take kindly to transportation from one climate to another. Hobson (4) states that the native proprietors of Angora flocks in Asia Minor unanimously assert that this goat can not be transported from the place where it was born to a neighboring village of a different altitude without suffering a deterioration, and although able to resist both heat and cold they can not withstand much humidity, either in their pastures or folds.

The second precautionary measure is closely allied to the first, namely, Angora goats should be provided with stables that are thoroughly dry, not alone in their ability to shed rain, but on account of being erected upon ground that has perfect natural drainage, and these should be accessible by them at all times, as the effect of rains

upon the general health and strength of these animals has been frequently proved to be very disastrous. So great is their natural aversion to a wetting that they will seldom get caught out in a shower if shelter is within their reach, but will leave their browsing and march under cover before the downpour arrives. The reason for this is obvious. Their fleece is wholly lacking in yolk; consequently it will not shed water in the least, and a fall of rain immediately soaks the animal clear to the skin.

As a third measure of prevention may be mentioned careful feeding. No animal is as well fortified against the attack of an infection when reduced by lack of nourishment as it is when in vigorous, thriving condition. Among the predisposing causes of disease usually enumerated by general pathologists will be found debility due to insufficient or unsuitable food, and, although the reason for this may not be established beyond the reach of argument, it is pretty generally conceded that the continued lack of proper nourishment establishes in the blood of an animal an abnormal degree of alkalinity which grants an increased susceptibility to the inroads of pathogenic organisms.

Another preventive measure to be mentioned here is one that is applicable only after the disease has made its appearance in the flock. The segregation or isolation of all affected animals as soon as they evince any symptoms of the disease will be found a most valuable means of protection for those that remain unaffected, and a strict quarantine over all of the diseased members of the flock should be maintained so long as the disease remains upon the premises.

In our previous experiments for the purpose of procuring an immunizing agent against this disease, the results were such as to warrant a practical application of the sterile filtrate previously described (p. 26) to several flocks of goats generously placed at our disposal. The fluid thus prepared has been injected into the skin over the shoulder of goats in doses of 3 c. c., with varying results. One flock, originally consisting of eighty-two animals, had been decimated by takosis until it numbered but thirty-two. These animals received two inoculations ten days apart, and immediately after the last injection they were transported in wagons late in November to a point thirty-eight miles away. On account of the condition of the roads, the trip required about two days. During this time the goats were without food or drink and were not unloaded. Two of them died, one on its arrival at the farm and the other not till three days later, although it was scouring badly upon reaching its destination. The remainder of the band seem in a healthy condition and are the most sturdy of the flock of six hundred to which they have been added. At a later test of this filtrate, made in one of the Western States, upon a flock of goats, the effect of treatment was most unsatisfactory. The goats were inoculated twice with the remedy with an interval of ten

days. Recent letters from the owner state that there is no improvement in the condition of the flock, but that the fatalities continue to occur with the usual frequency. He has since been advised to make use of the medicinal treatment mentioned below. From another Western breeder a most flattering report has been received. He states that after the use of the prophylactic treatment the disease disappeared from the premises, and up to the time of writing all of the animals on the place had remained in a thriving condition.

THERAPEUTICS.

Medicinal treatment has proved unsatisfactory in many of the cases of takosis to which it has been applied. Previous to the study of the disease the treatment was directed against the pneumonia, and for a short time marked improvement followed; but it was merely coincidental, as deaths occurred later with the usual regularity. Then intestinal disinfectants and astringents were suggested, but these did not prove efficacious. The most pleasing results that have been derived from the use of drugs in our experiments at the laboratory have followed the administration of calomel given alone in 0.10-gram doses twice daily for two days, to be followed by powders composed of arsenic, iron, and quinine, as follows:

	Grams.
Arsenious acid	1.40
Iron, reduced	12.00
Quinine sulphate	6.00

Mix and make into twenty powders, giving one to each adult goat morning and evening at the conclusion of the administration of calomel. After an interval of two days, this treatment is repeated. In case the diarrhea persists, the sulphate of iron has been substituted for the reduced iron, with beneficial effects.

CONCLUSIONS.

As a result of the present preliminary investigation, the following conclusions have been reached:

1. The disease here described as takosis has appeared in many parts of this country, but particularly in the Northern States, where it has caused great loss to many breeders of Angora goats.

2. It is a progressive, debilitative, contagious disease, characterized by great emaciation and weakness, with symptoms of diarrhea and pneumonia, and causes a mortality of 100 per cent of those affected and from 30 to 85 per cent of the whole flock.

3. From the carcasses of numerous animals that have succumbed to this disease a new organism, *Micrococcus caprinus*, has been recovered in purity and is presumably the etiological factor.

4. This micrococcus possesses pathogenic properties for goats,

chickens, rabbits, guinea pigs, and white mice, but not for sheep, dogs, or rats.

5. Although the disease has been described before (11), so far as could be ascertained no bacteriological investigations have been previously made.

6. Medicinal treatment was attempted with varying success, while the immunizing experiments thus far conducted (although too few to permit of any conclusive statement or accurate estimate as to their protective value), have shown highly encouraging results. When accompanied with measures of isolation and disinfection, the treatment may prove of great assistance in the suppression and eradication of the disease in an infected flock.

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U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY—BULLETIN No. 46.
D. E. SALMON, D. V. M., Chief of Bureau.

THE MILK SUPPLY

OF

TWO HUNDRED CITIES AND TOWNS.

BY

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AND

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1903.

LETTER OF TRANSMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
Washington, D. C., May 15, 1903.

SIR: I have the honor to transmit herewith a manuscript dealing with all phases of the milk supply of two hundred cities and towns in the United States, and recommend that it be published as Bulletin No. 46 of the series of this Bureau.

Respectfully,

D. E. SALMON,
Chief of Bureau.

Hon. JAMES WILSON,
Secretary of Agriculture.

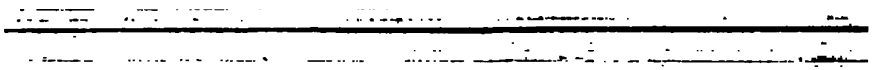
PREFATORY STATEMENT.

This report upon "The milk supply of 200 cities and towns" is very largely the work of Mr. R. A. Pearson, the Assistant Chief of the Dairy Division prior to September last.

If the full statistics of the market milk industry could be given, the importance of this form of dairying would be better appreciated. It is not known how many persons are actually engaged in the production, transportation, and sale of milk for market. Based upon the Twelfth Census of the United States, about 1,000,000,000 gallons of milk are sold annually by the owners of the producing cows, for consumption in the natural state or for household purposes. The value of this product, joined with the capital invested in production, transportation, distribution, and delivery, constitutes an interest of great magnitude.

The business is also one of interest and importance to a vast army of consumers. It is not surprising, therefore, to find so much attention being given to the improvement of this branch of dairying. A knowledge of what has already been accomplished and what is now being done to promote this good work should contribute to further progress. It is with that view that the facts included in the accompanying report have been collected and compiled.

HENRY E. ALVORD,
Chief of Dairy Division.



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Supervision of the production and handling of market milk		19
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CATALOGUE OF CITIES.

[Including all of the 161 cities in the United States having a population over 25,000 each, also 39 selected cities and towns of smaller size.]

States and cities, population, and page reference to discussion of dairy data.

[Populations are according to the Twelfth Census.]

States and cities.	Population.	Page.
Alabama:		
Mobile	38,469	45
Birmingham	38,415	45
Montgomery	30,346	46
Arizona		47
Arkansas:		
Little Rock	38,307	47
California:		
San Francisco	342,782	47
Los Angeles	102,479	48
Oakland	66,960	49
Sacramento	29,282	50
San Jose	21,500	50
Alameda	16,464	51
Colorado:		
Denver	133,859	51
Pueblo	28,157	52
Colorado Springs	21,085	53
Trinidad	5,345	53
Connecticut:		
New Haven	108,027	54
Hartford	79,850	54
Bridgeport	70,996	55
Waterbury	45,859	55
New Britain	25,998	56
Delaware:		
Wilmington	76,508	56
District of Columbia:		
Washington	278,718	57
Florida:		
Jacksonville	28,429	59
Georgia:		
Atlanta	89,872	59
Savannah	54,244	60
Augusta	39,441	60
Hawaii:		
Honolulu	39,306	60
Idaho		61
Illinois:		
Chicago	1,698,575	62
Peoria	56,100	66
Quincy	36,252	66
Illinois—Continued.		
Springfield	34,159	67
Rockford	31,051	67
East St. Louis	29,655	67
Joliet	29,353	67
Aurora	24,147	68
Evanston	19,259	68
Moline	17,248	69
Ottawa	10,588	69
Indiana:		
Indianapolis	169,164	70
Evansville	59,007	71
Fort Wayne	45,115	72
Terre Haute	36,673	72
South Bend	35,999	72
Richmond	18,226	73
Iowa:		
Des Moines	62,139	74
Dubuque	36,297	74
Davenport	35,254	74
Sioux City	33,111	75
Council Bluffs	25,802	75
Cedar Rapids	25,656	75
Burlington	23,201	76
Clinton	22,698	76
Ottumwa	18,197	77
Keokuk	14,641	77
Marshalltown	11,544	77
Kansas:		
Kansas City	51,418	78
Topeka	33,608	78
Kentucky:		
Louisville	204,731	79
Covington	42,938	80
Newport	28,301	80
Lexington	26,369	80
Louisiana:		
New Orleans	287,104	81
Maine:		
Portland	50,145	82
Lewiston	23,761	82
Waterville	9,477	82
Belfast	4,615	83

States and cities, population, and page reference to discussion of dairy data—Continued.

States and cities.	Population.	Page.
Maryland:		
Baltimore	508,957	84
Massachusetts:		
Boston	560,892	86
Worcester	118,421	87
Fall River	104,863	88
Lowell	94,659	89
Cambridge	91,886	90
Lynn	68,513	90
Lawrence	62,559	91
New Bedford	62,442	91
Springfield	62,059	92
Somerville	61,643	92
Holyoke	45,712	93
Brockton	40,063	93
Haverhill	37,175	94
Salem	35,956	94
Chelsea	34,072	94
Malden	33,664	95
Newton	33,587	95
Fitchburg	31,531	96
Taunton	31,036	96
Gloucester	26,121	96
North Adams	24,200	97
Woburn	14,254	97
Melrose	12,962	97
Wakefield	9,290	98
North Attleboro	7,253	98
Michigan:		
Detroit	285,704	100
Grand Rapids	87,565	101
Saginaw	42,345	101
Bay City	27,628	101
Jackson	25,180	102
Battlecreek	18,563	102
Lansing	16,485	103
Minnesota:		
Minneapolis	202,718	103
St. Paul	163,065	104
Duluth	52,969	105
Mississippi		106
Missouri:		
St. Louis	575,238	106
Kansas City [a]	215,170	107
St. Joseph	102,979	108
Joplin	26,023	108
Montana:		
Butte	30,470	109
Nebraska:		
Omaha	102,555	109
Lincoln	40,169	110
South Omaha	26,001	110
Nevada		111
New Hampshire:		
Manchester	56,987	111
New Jersey:		
Newark	246,070	112
Jersey City	206,433	114
Paterson	105,171	114
Camden	75,935	115
Trenton	73,307	115
Hoboken	59,364	116
Elizabeth	52,130	116
Bayonne	32,772	116
Atlantic City	27,838	117
Passaic	27,777	117
New Brunswick	20,006	117
Montclair	13,962	117
New Mexico		123
New York:		
New York	3,437,202	124
Buffalo	352,387	127
Rochester	162,608	128
Syracuse	108,374	129
Albany	94,151	130
Troy (and Lansingburg)	73,246	131
Utica	56,383	131
Yonkers	47,931	132
Binghamton	39,647	132
Elmira	35,672	133
Schenectady	31,682	133
Auburn	30,345	133
Watertown	21,696	134
Mount Vernon	21,228	134
Lockport	16,581	135
Rome	15,343	135
North Carolina		136
North Dakota		136
Ohio:		
Cleveland	381,768	137
Cincinnati	325,902	137
Toledo	131,822	138
Columbus	125,560	139
Dayton	85,333	139
Youngstown	44,885	140
Akron	42,728	140
Springfield	38,253	140
Canton	30,667	140
Hamilton	23,914	141
Warren	8,529	141
Fostoria	7,730	142
Oklahoma		142
Oregon:		
Portland	90,426	143
Pennsylvania:		
Philadelphia	1,293,697	141
Pittsburg	321,616	145
Allegheny	129,896	146
Scranton	102,026	146
Reading	78,961	147

[a] Including Kansas City, Kans.

States and cities, population, and page reference to discussion of dairy data—Continued.

States and cities.	Population.	Page.
Pennsylvania—Continued.		
Erie	52,733	147
Wilkesbarre	51,721	148
Harrisburg	50,167	148
Lancaster	41,459	148
Altoona	38,973	149
Johnstown	35,936	150
Allentown	35,416	150
McKeesport	34,227	150
Chester	33,988	150
York	33,708	150
Williamsport	28,757	151
Newcastle	28,339	151
Easton	25,238	151
Lebanon	17,628	151
Meadville	10,291	152
Phœnixville	9,196	152
Rhode Island:		
Providence	175,597	153
Pawtucket	39,231	154
Woonsocket	28,204	154
South Carolina:		
Charleston	55,807	154
South Dakota		155
Tennessee:		
Memphis	102,320	155
Nashville	80,865	156
Knoxville	32,637	156
Chattanooga	30,154	156
Texas:		
San Antonio	53,321	156
Houston	44,633	157
Dallas	42,638	157
Galveston	37,789	157
Fort Worth	26,688	158
Utah:		
Salt Lake City	53,531	158
Vermont		158
Virginia:		
Richmond	85,050	159
Norfolk	46,624	159
Washington:		
Seattle	80,671	160
Tacoma	37,714	160
Spokane	36,848	160
West Virginia:		
Wheeling	38,878	161
Wisconsin:		
Milwaukee	285,315	162
Superior	31,091	163
Racine	29,102	163
La Crosse	28,895	163
Oshkosh	28,284	164
Greenbay	18,684	164
Marinette	16,195	164
Waukesha	7,419	165
Wyoming		165

THE MILK SUPPLY OF TWO HUNDRED CITIES AND TOWNS.

INTRODUCTION.

No branch of the dairy industry has received more attention in recent years or made more substantial progress than that of producing milk for delivery to consumers or shipment to market. Nearly one-third of all the milch cows in the United States are necessary to supply the people with milk for use in its natural state.

The demand for improvement in the milk supply and milk service has led to much better practices on the part of many of those connected with different phases of the business. Producers give more care to the selection and breeding of cows, their health and housing, food and water; to the matter of cleanliness in milking and the care of milk while on the farm. There have been marked improvements in vessels and methods of shipping, means and manner of transportation, storage, distribution, and delivery. The small glass jar, or bottle, as a complete and sealed vessel, to pass unopened from producer to consumer, if desired, is a great advance in equity, purity, and security of delivery. It has been rapidly improved from the clumsy form in which it was introduced twenty-five years ago, and has almost reached perfection as a glass vessel for this purpose. It is yet too heavy, short lived, and expensive, however. The ideal package for milk carriage and delivery, light, clean, safe, and so cheap as to be used only once and then destroyed, has yet to be found.

Municipal governments, as well as voluntary civic organization and private enterprise, are giving more and more attention to this important subject of the milk supply, its proper regulation, supervision, management, and improvement.

Much reformatory work is still needed in the improvement of all those parts of the business which are within the control of the producing farmers. This requires the united efforts of all public and private agencies which can be interested in it and brought into action.

More important is the system, or present lack of system, in distribution and delivery. Producers and consumers are jointly carrying an untold burden in supporting armies of men and "means of transportation" engaged in duplication, or rather multiplication, of labor,

where intelligent cooperation would be a distinct benefit to all concerned. Here and there some encouraging work has been done, but the problem needs to be earnestly studied. A great opportunity awaits the successful practical reformer in this important field.

It is desirable to know what has already been done and what measures have been found efficacious, in order to guide new movements or revise old ones in the same direction. To this end the compilation of facts has been made which will be found in the following pages. The report shows the legal requirements as to market milk in every State and Territory having laws upon the subject, and includes a more or less detailed account of the milk supply of all the 161 cities in the United States having a population over 25,000 each; also of 39 selected cities and towns of smaller size, the smallest being Belfast, Me., with a population of 4,615. The information given is nearly all based upon official documents and special reports from officers who are charged with the enforcement of so-called milk laws and ordinances.

Present conditions are well set forth in the material collected. In numerous instances recommendations for improvement are included, as given by health officers and milk inspectors. This does not imply that they are indorsed, although many of them are worthy of indorsement. This Department has recently published an article under the title, "Market milk: A plan for its improvement,"[a] which was prepared after a careful study of much of the material used in the present report. It sets forth a plan which, it is believed, could be followed in any town or city where there is a live interest in the subject. That plan applies chiefly to the further improvement of the better class of dairies and would have little direct influence on the poorest. It should therefore be supplemented by certain legal requirements and their thorough enforcement. The report now presented will be especially useful in places where some regulation of the milk supply is first contemplated or where better regulations are needed. The correspondence of the Dairy Division shows there are many such, including cities and towns having no legal provisions whatever in reference to milk. Inquiries have come in large number for suggestions as to the best way to supervise market milk, and especially as to methods generally employed.

It is hoped that this summary statement of conditions now prevailing throughout the country in reference to market milk will encourage action toward the improvement of that important food supply and lead to a larger use of it. So much has been said and written regarding impure market milk that many persons have become unnecessarily alarmed. For this reason any fair inquiry into this subject which brings out facts and suggests steps that should be taken for the benefit of the industry should be welcomed by milk inspectors and consumers as well as milk producers and dealers.

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[a] Seventeenth Annual Report, Bureau of Animal Industry (1900), pp. 158–193.

STATISTICS AND GENERAL INFORMATION.

The usual methods by which milk is distributed in cities, towns, and villages are known to every observing person, and those by which it is produced are known to most people; but statistical facts regarding the use of milk are not generally known, although they are exceedingly interesting and suggestive. All of the statistics obtained relating to the market milk of the two hundred municipalities have been arranged in tables (pp. 26–44), in which data for any city or town can be readily seen and compared with others. Only a few of these statistics will be repeated here. Figures showing the total amount of milk used in large cities are very impressive, but they do not give the extent of the use of milk as well as those representing its per capita consumption or supply. The following statement shows the maximum, minimum, and average number of pints of milk apparently consumed daily in each of the four classes into which the cities and towns have been arranged:

Daily per capita supply of milk.

	Class I.	Class II.	Class III.	Class IV.
Number of cities reporting	38	39	63	39
Maximum.....pints..	1.17	2.00	1.42	1.18
Minimum.....do....	.27	.10	.12	.23
Average.....do....	.61	.63	.58	.57

It is believed that these figures are reasonably accurate. They are based upon the population according to the last census and estimates of milk used daily furnished by local officials best qualified to judge. In not a few cases careful records are kept by milk inspectors of the milk sold by each person having a license, but generally it has been necessary to depend upon estimates. Whenever the estimates appeared to be unreasonably large or small, they were returned for revision.

The average quantity of milk per capita provided in the daily supply and presumably consumed in the largest cities (Class I) is found to be 0.61, or practically two-thirds, of a pint; in cities of Class II (including all those with a population between 50,000 and 100,000), the average consumption is 0.63 pint; in Class III (cities having a population between 25,000 and 50,000) it is slightly less, or 0.58 pint; and the average of 39 cities and towns, with a population less than 25,000, is 0.57 pint. In Boston, Worcester, Newton, and Fitchburg, Mass.; Elizabeth and Hoboken, N. J.; Providence, R. I.; Minneapolis, Minn.; Pueblo, Colo.; Elmira and Mount Vernon, N. Y.; and Sioux City, Iowa, the average daily per capita consumption of milk is reported as 1 pint or more. By referring to the separate statements for these cities it will be seen that some explanation is usually given for this

seemingly large use of milk. The smallest average consumption of milk in the larger cities is 0.27, or practically one-fourth, of a pint per capita; this is in New Orleans, where the supply is notably inadequate and unsatisfactory. The average per capita consumption of milk in four of the largest Southern cities is only 0.38 pint, which is less than one-half of the average supply in large Northern cities.

Satisfactory statistics concerning skimmed milk were obtained from only a few of the larger cities reporting. In Indianapolis, Ind., and St. Joseph, Mo., the largest amounts were given, the supply being about one-third of a pint per capita, in addition to the whole milk used. Several cities reported a little less than 0.1 pint, and several others as little as 0.01 pint per capita. Boston, Mass.; Jersey City and Elizabeth, N. J.; New York, N. Y.; St. Louis, Mo.; and Bridgeport, Conn., report that no skimmed milk is used.

The quantity of cream per capita in the larger cities varied in supply from 0.01 pint daily to 0.19 pint.

The number of stores and wagons engaged in the sale and distribution of milk shows that the methods of handling it differ considerably in different places. Milk is sold from 12,000 stores in New York City, or an average of 1 store to every 286 persons, and it is delivered from 4,000 wagons, or an average of 1 wagon to every 859 persons. In all the cities of Class I, there is an average of 1 store to 1,176 persons, and in Class II, to 2,149 persons, showing that in the smaller cities wagons are mainly depended upon. In cities of the first two classes, including all with a population above 50,000, there is an average of 1 wagon to about 784 persons. A factor to be considered in this connection is the number of cows within the city limits. Some cities report several thousand cows in herds within their boundaries, and most cities have quite a number of cows kept singly for the private use of the families owning them.

The tables show a wide variation in the prices paid for milk in different parts of the country. Producers usually receive, on their farms, from 2 to 3 cents per quart in the summer and 3 cents or more in winter, but these limits are often exceeded. On the other hand, in some cases and in some seasons, producers receive less than 2 cents a quart. It was attempted to ascertain the exact prices received by producers on their farms, but in some cases the question seems to have been misunderstood, and the price reported was apparently that paid for the milk delivered in the city. Allowance should be made for this possible error, especially whenever the price seems to be too high. The average price paid by consumers of milk when retailed in small quantities is about 6 cents in summer and 7 cents in winter.

In numerous instances an advance of 1 or 2 cents per quart for milk from "model dairies" is reported. But the milk from many so-called model dairies is sold at the same price as other milk, and in

most of these cases the term probably refers to dairies that are conducted in a manner only slightly better than the ordinary. The term "model dairy" is differently understood by different persons, hence the number of these dairies reported to be near cities and towns can not be fairly compared. Usually only one, two, or three are reported for a city and often none.

A truly "model dairy" is one which is conducted in the best practicable manner known to science. They are not necessarily places where money has been lavishly expended for fine blooded cattle and highly adorned buildings; such places, if they are not properly conducted, are far from "model." But they are dairies where milk is produced and handled that is as clean and wholesome as milk can be made; the cows are in good condition, free from disease in any stage, and frequently examined by a skilled veterinarian, who removes from the herd any suspicious animals; none but wholesome feeds are used; the stable is abundantly lighted and well ventilated, often thoroughly cleaned and kept in a correct sanitary condition; the cows are kept clean and comfortable; the attendants are healthy and cleanly; all utensils are sterilized daily; great care is taken to protect the milk from contamination; the milk is promptly cooled, and it should contain less than one one-thousandth part as many bacteria as are found in much of the milk regularly sold in cities and towns.

A model dairy does not require a large outlay of capital, but it requires a keen intelligence and unremitting care in its management. Some increase in running expense is necessary, as would be expected. Such dairies are few, but their number is slowly increasing. One of the chief reasons why they do not increase more rapidly is that the public does not appreciate the advantages of their product and seems unwilling to pay a slightly advanced price for it. If the question were generally understood, there would be such a demand for high-grade milk at fair prices that model dairies would quickly come to be the rule instead of the exception. When consumers are willing to pay enough to encourage dairymen to exercise close supervision over their cows and to take all of the precaution necessary to insure milk of high quality and purity, from both chemical and bacteriological standpoints, and will insist on having such milk, then that kind will be amply supplied. It is the duty of dairymen themselves to help bring about this condition. Milk is cheaper than most other foods (even when it is sold at an advanced price made necessary by extra care in its production), and for this reason, as well as others, it is well suited to form a large part of the dietary.

The territory from which milk is supplied to cities and towns might be divided into three zones. The first includes the city itself, which often, as has been stated, has large numbers of cows within its limits; the number is sometimes in the thousands. The second zone includes

the district surrounding the city, from which milk is carried by wagons. These wagons usually arrive in the city in time to serve milk early in the morning; they may deliver the milk of the previous day or the milk of the same morning and the previous evening. The third zone includes a much greater territory, from which milk is carried to the cities by railroads, trolley lines, and steamboats. In about a dozen cities more than three-fourths of the supply comes from this zone. Seven cities—New York, Philadelphia, Newark and Jersey City, N. J., Baltimore, Md., Memphis, Tenn., and Lynn, Mass.—report milk received from points distant 200 miles or more. The average of the longest distances from which milk is supplied to cities of Class I is practically 100 miles, while the average of the longest distance from which it is supplied to cities of Class II is practically 50 miles. The milk trains bringing milk from medium distances to the cities usually arrive between 8 and 11 o'clock in the morning with milk of the same morning and previous evening. Much of this is held over in refrigerator tanks of the dealers to be served the following morning, when a part of it is twenty-four hours old and the remainder thirty-six hours. Trains carrying milk the longest distance usually arrive in the night, so that their milk can be served the following morning and is not any older than much of that coming from nearer points.

The portion of milk delivered in glass bottles was stated for only about half of the cities reporting. In some cases almost all of the supply is handled in this way. It appears from the reports that the average retail price is no higher in cities where a large portion is served in bottles than in cities where bottles are but little used. The delivery of milk and cream in bottles is increasing in favor. This should be so, for the system has many advantages. Each bottle is a sufficiently exact measure, holding a quart, pint, or half pint, and unless it has been very carelessly filled, contains its right proportion of cream. Bottles are closed packages and thoroughly protect their contents from dust and foul air. They may be easily sealed and their contents guaranteed. The bottles are heavy and fragile and expensive, but the greatest objection to their use is on account of their abuse. They are sometimes refilled without having been properly cleansed. This is a dangerous practice, as milk might be put into jars that had been in some way infected with the germs of a contagious disease, and thus carry the disease to other houses and families. Milk jars are easily sterilized, and whenever this is done there seems to be no serious objection to counterbalance the many advantages of their use.

The pasteurization of market milk is not generally practiced. A few cities report that a small portion of the milk is thus treated. According to returns, the largest quantities of pasteurized milk are sold in Los Angeles, Cal.; Pittsburg, Pa.; St. Paul, Minn.; Kansas City, Kans.; Salt Lake City, Utah; Reading, Pa.; Troy and Bingham-

ton, N. Y.; Council Bluffs, Iowa; and Lexington, Ky. Several cities report that no pasteurized milk is sold within their limits. The practice of pasteurization appears to be gradually extending. Yet the medical fraternity is divided in opinion as to its expediency, and the best sentiment favors natural milk produced and delivered in such a pure and protected condition as to be greatly superior to any pasteurized article. Too often milk is offered for sale with the claim that it has been pasteurized, when it has actually been more harmed than helped, the process to which it has been subjected being unworthy the name. If done at all, pasteurization should be in the hands of competent persons, having efficient apparatus.

MILK LAWS AND ORDINANCES.

In thirty-five States there are laws referring to market milk. In nine other States (and Territories) there are pure-food laws which have a bearing upon the milk supply. In twenty-six States there are officials whose special duty it is to enforce these laws. Full copies of all the laws but two or three of the latest are included in previous publications of the Dairy Division. Almost every city and many towns and villages have ordinances or board of health regulations concerning the milk supply. Abstracts showing the State requirements and also the local requirements, so far as available for the 200 cities and towns here reported upon, will be found in the following pages. (In the abstracts, effort is made to state only the most important features, often omitting the repetition of details of enforcement, the usual authority for inspectors to perform their work, methods of taking samples, etc.) In addition to the special milk laws, general pure-food and sanitary laws and regulations are sometimes construed to apply to milk.

Too often milk laws and ordinances are faulty because their requirements are not clearly expressed. The form of expression is sometimes so cumbrous that the meaning is unintelligible to the average reader, or the requirements may be vague or obviously inexact, or they may be expressed in very general terms, thus rendering execution practically impossible. For example, some laws prohibit the use of any cow feed that is fermented. A strict interpretation of this would exclude silage, a most excellent dairy feed. This could hardly have been intended; but, if one feed is excepted, the exemption of other fermented feeds could be demanded. A law may require dairy stables to be well lighted. What does this mean? A stable considered by some persons to be well lighted would be very poorly lighted from the standpoint of others. A better way of expressing this requirement would be to name a minimum number of square feet of unobstructed windows for a given cubic space within.

On the other hand, some laws and ordinances go to the opposite

extreme. They seem to show an effort to include the regulation of almost every detail of dairy work. It is generally considered impracticable to enforce such laws, and gradually their requirements are more and more ignored until attention is given to none of them or to only a few that can be most easily enforced.

It is an open question whether State laws or local regulations may be the more efficient in improving the milk supply. It is the general practice to leave to local authorities all control after the milk is within the city limits, but in a few cases States exercise authority within the cities and towns as well as elsewhere. It is probably true that the milk supply of the smaller towns receives better official attention when its control is in the hands of the State. State inspectors visit the small towns occasionally, at least when it is shown that their presence is needed, and this is much better than no inspection, which is the rule in many towns like the one from whose health officer the following letter was received:

> It is humiliating to be compelled to confess that a city which is well advanced in all other matters of sanitation should be without ordinances regarding the milk supply. On two different occasions before the city council assembly I moved that such ordinances be enacted, and both times the matter was shelved for the alleged reason that it might offend the susceptibilities of some milk venders.

The argument that the State should control the milk supply, because local regulations have no force beyond the city limits, has been shown by numerous cities to have little weight. In places which are not sufficiently protected by the laws of the States in which they are situated or the laws of other States from which milk is received, the matter is thus managed: It is provided by local ordinance that no milk shall enter the corporate limits unless it comes from a dairy holding a permit, or license, from the city authorities. The city can make its own conditions for issuing permits. These are usually given only to dairies actually inspected or which furnish satisfactory evidence of being in approved condition. The permits may be canceled for cause. A thorough system of milk and dairy inspection on this basis affords ample protection to milk consumers, as the source of the milk supply can be held completely under local control.

City ordinances relating to milk supply are similar to State laws, but generally more detailed and more clearly stated. They are often supplemented by regulations and rules of the local boards of health. The character of the city requirements, as well as those established by State authority, can best be ascertained by examining the abstracts of the laws, ordinances, etc., which are given elsewhere in separate statements for cities and towns. A few milk ordinances are printed in full in Appendix I (p. 165); also a number of sections taken from other ordinances which are of interest, because they show commendable ways for prescribing different requirements.

The subjects of most frequent legislation in connection with the supervision of market milk are shown by the statement below. The milk ordinances and regulations of 126 cities were examined with especial care, and the number of those having similar requirements are given. The most popular subjects for legislation are thus readily seen:

Subjects of most frequent legislation in connection with market milk.

Subjects.	Number of cities.	Subjects.	Number of cities.
Dairies:		Care of milk:	
License or permit required	12	Milk vessels to be nonabsorbent	5
Special authority for inspections	58	Milk vessels to be thoroughly cleaned	32
Pure water supply	8	Milk to be promptly removed from the stable	11
Drainage of barnyards	12	Straining	9
Stables:		Cooling and aerating	15
Proximity to other buildings	6	Conditions of storage	23
Light	15	Sale of milk:	
Ventilation	32	Licenses, or permits	92
Floor space	15	Licenses to be publicly displayed	24
Air space	10	Source of supply to be posted	14
Cleanliness	47	General inspection in cities	75
Removal of manure	25	Signs on wagons	79
Drainage	17	Unsanitary milk prohibited	109
Other than dairy animals to be excluded	4	Confiscation of impure milk	30
Sanitary milk room	14	Definite standard for composition	67
Employees:		Skimmed milk prohibited	12
Personal cleanliness	20	Skimmed milk permitted conditionally	61
Contagious disease (to be reported)	15	Bottling at farm	8
If exposed to contagious disease	25	Storage of milk for sale	23
Cows:		Milk tickets to be used but once	16
Provisions for examination	58	Milk wagons to be covered	12
Diseased cows	24	Milk wagons not to carry garbage	5
Unwholesome food forbidden	77	Sellers to register customers	7
Pure water supply	40		
Cleaning cows	27		
Milk rejected at calving time	33		

In most places having ordinances the sale of unsanitary milk is prohibited, but not infrequently in such general terms that the prohibition is practically without force.

The usual standard required for milk is 12 per cent total solids, including 3 per cent of fat. In a few cases higher standards are in force during all the year except the summer months. In some ordinances the standard is expressed in this peculiar manner: "Milk shall contain at least 12 per cent of milk solids, of which 3 per cent shall be fat." This literally means that the milk must contain three one-hundredths of twelve one-hundredths, or much less than 1 per cent of fat.

So much trouble has been experienced in some cities in regulating the sale of skimmed milk that in a few cases the sale of this cheap

and excellent food is prohibited. The difficulty arises from the fact that dealers are allowed to carry skimmed milk in the same vehicles with whole milk or keep it in the same refrigerators or chests. It is then a simple matter to substitute the one for the other in selling to customers who are incapable of detecting the difference or unable to get redress. Some cities require all skimmed milk to be sold from cans that are painted blue or another distinguishing color. In one place the vender must give to the consumer a printed slip on which it is stated in large type that the milk is skimmed. In one or two other places skimmed milk must be peddled in vehicles different from those used for whole milk. Such methods have been proved so simple and effective that they should be adopted in cities where skimmed milk is now excluded. A good supply of this article, sold honestly on its merits, is of so much benefit to consumers, and especially to the poorer classes, that prohibition of its sale is inexcusable.

Many different penalties are provided for the violation of milk laws. They are usually fines and imprisonment, but in a few towns it is required that the names of violators be published, thus notifying the public who have been convicted of selling poor milk.

In many cases milk dealers have adopted the commendable practice of issuing rules and instructions to the producers supplying them with milk. A copy of a set of these rules is shown in Appendix II (p. 181). Such rules are a most valuable supplement to the ordinances. The "Fifty dairy rules" issued by this Department, in suitable form for posting in stables and milk rooms, have been widely distributed to dairymen through milk dealers and milk inspection officials, and by being published in various places.

An excellent list of the conditions which should be found at a well-conducted dairy is given in Appendix III (p. 182). These requirements form the chief part of the contract between the Essex County (N. J.) milk commission and the dairyman whose milk receives the indorsement of this commission.

No attempt is now made to offer what might be called an ideal milk law. Such would be suggestive in the many cities and towns where new legislation is being considered, but it is believed that suggestions as useful can be had by a study of the laws which are already in force. An ordinance suitable in one city or town might be quite inapplicable in another. For example, the larger cities, where dealers purchase their milk in such a way as to know practically nothing of its source, should have laws different in many respects from those in force in places where all the milk sold is produced by the persons who sell it. The regulations should be as clear and brief as possible, and those relating to milk should be enacted together, so they can be printed separately for distribution. In many cases the distribution of ordi-

nances is rendered almost useless because they are long and cumbersome, or because the milk regulations are mingled with those on other subjects. In one city requirements regarding the milk supply alternate with those regarding the burial of the dead.

It is a serious mistake not to consult with reputable dairymen and dealers when laws concerning them are being considered. Such persons welcome the enactment and rational enforcement of proper measures to regulate the production and sale of milk. The prohibition of adulteration and unsanitary methods helps their business by driving out competitors whose false claims of excellence succeed in holding the trade of many customers.

SUPERVISION OF THE PRODUCTION AND HANDLING OF MARKET MILK.

With very few exceptions, there is some supervision of the milk supply in all cities in the United States having a population over 50,000. Much less supervision is exercised in cities with a population between 50,000 and 25,000, and in smaller cities and towns supervision is the exception rather than the rule. It is easily seen that in small places, where persons are known or may soon become more or less known throughout the entire community, the same need for official attention to the milk supply does not exist as in more populous centers. Yet this is not sufficient reason for ignoring the subject altogether, as is too often done.

There is the widest variation in the methods followed in different places and the character of the work performed. As stated, in many cities and towns this matter receives no attention, or almost none, and, in some of these, adulterations and general neglect of sanitary measures may be found on every hand, if the replies to inquiries from this office may be relied upon. But it should be added that in some places, where there is little or no supervision, the quality of the milk is excellent.

As has been explained, most of the States have more or less definite laws relating to the milk supply of cities and towns. In very few of them, however, is there any real effort at supervision by State officials. In Iowa and New York and one or two other States regular corps of milk inspectors are kept in the field. Some are located permanently in the larger cities and others make occasional unannounced visits to smaller places. In general these officials plan their own routes, and respond promptly to calls from places where their presence is particularly desirable. Their duties are largely the examination of milk samples for adulteration. The lactometer is relied upon mainly to indicate suspicious samples, and these are later subjected to more accurate tests. The effect of a visit of the State milk inspector to one

town, where he is apparently too seldom seen, is shown by this statement from the health officer:

> The only protection the citizens have had from impure milk is an occasional visit from a State milk inspector, who invariably caught an offender and emptied his cans in the gutter; and some of the other dealers hearing of it, hurried back to their homes and left their customers unsupplied.

Some inspections of the sanitary conditions of dairies and milk stores are made by State authorities, but these are not customary except for special cause, such as an outbreak of disease or evidence of unusual conditions requiring attention. The New Jersey board of health has prepared blanks on which reports of inspections are made and which show how thorough it is proposed they shall be in that State. (See Appendix IV, p. 187.)

Although in some cities and many towns there is no local supervision of the milk supply, except an occasional action of the board of health or police in connection with a particularly flagrant case, yet, on the whole, there is much more work done along this line by local officials than by State officials; the former, however, often act under State laws.

Milk ordinances and regulations being considered health measures, their enforcement is generally intrusted to the board of health. When it is proposed to accomplish something along this line, special officers are appointed to take charge of the work. They are usually given the title of "milk inspector," but not infrequently their titles are longer and indicate additional duties, such as "inspector of milk and vinegar," "inspector of milk, provisions, kerosene oil, and vinegar," etc.

Officials in most of the cities having a population over 100,000 (Class I) reported fully upon the work performed in the supervision of their milk supply, and officials in a large portion of the cities with population between 50,000 and 100,000 (Class II) did likewise. Details could be furnished from only a small portion of the cities between 25,000 and 50,000 population (Class III), and of those of less than 25,000 population (Class IV). From these reports interesting data were obtained, which are tabulated as follows:

Abstract of interesting items from cities of the different classes.

Items and grouping of same.	Class I.	Class II.	Class III.	Class IV.
Amount annually expended in supervision of the milk supply:				
Cities reporting	29	33	40	31
Largest amount reported	$13,000	$2,500	$2,500	$1,200
Smallest amount reported	$1,000	0	0	0
Average amount reported	$2,953	$685	$421	$282
Milk samples tested for composition:				
Cities reporting	37	32	52	38
Largest number reported	79,657	12,000	5,000	4,000
Smallest number reported	0	0	0	8
Average number reported	6,834	1,076	521	471

Abstract of interesting items from cities of the different classes—Continued.

Items and grouping of same.	Class I.	Class II.	Class III.	Class IV.
Milk samples examined bacteriologically:				
Cities reporting	30	27	39	29
Largest number reported	390	125	43	275
Smallest number reported	0	0	0	0
Average number reported	77	7	2	16
Dairy herds in city limits:				
Cities reporting	29	25	34	29
Largest number reported	5,500	100	200	83
Largest number inspected reported	560	100	200	83
Smallest number reported	2	0	0	0
Smallest number inspected reported	0	0	0	0
Average number reported	297	21	21	12
Average number inspected reported	124	18	31	11
Dairy farms contributing to the supply:				
Cities reporting	17	18	37	30
Largest number reported	4,000	800	300	127
Largest number inspected reported	300	228	250	127
Smallest number reported	69	15	12	6
Smallest number inspected reported	0	0	0	0
Average number reported	686	167	65	38
Average number inspected reported	114	64	37	29

By an examination of these figures, as well as the separate reports upon different cities and towns, in another part of this publication, it is readily seen that most of the inspection work consists of testing samples of milk to ascertain if they contain as much fat and other solids as required by the standard. This is very useful, but certainly not more so than inspections for other conditions that may have even more effect upon the wholesomeness of milk than its adulteration by skimming or watering. The health of the cows producing milk, the health of the persons who handle it, and the conditions to which it is exposed are too often left out of consideration altogether by consumers as well as public-health officials. Yet there is little doubt that much more harm has resulted from the use of milk that has been contaminated through neglect of these things than from the use of adulterated milk. It is a commercial fraud to decrease the value of milk by the addition of a cheap ingredient, such as pure water, or by the removal of a valuable ingredient, such as fat (in cream), but this is insignificant compared to the evil of allowing milk to become dangerously contaminated, as may easily result when general sanitary conditions are neglected in connection with its production and care.

Milk laws, ordinances, regulations, etc., are usually quite well enforced, so far as the requirements regarding the composition of milk are concerned, but beyond that the enforcement is very imperfect. For example, it is commonly required that cows shall be kept in a healthful place and fed only wholesome food, etc., but such clauses are seldom noticed. Nothing whatever is known in most cities of the

source of a large part of the milk sold, as many farms are never inspected. The conditions at almost any city in this respect are well described in the report of an inspector at Washington, D. C., which is abstracted on page 58.

The methods of work are quite similar throughout, and all details need not be given here. It is practicable to keep a correct list of producing dairies and places where milk is sold by having them licensed. This is the first essential. It is then simply a question of finding everyone on the lists and keeping an office record of the results of the inspections. Special care must be taken in the collection and marking of samples, as these acts have to be fully described in prosecutions. The official report of the method employed in Boston is as follows:

Collections of samples for inspection are made on every week day and frequently on Sunday. The time varies very much according to circumstances, but most of them are made in the early morning and forenoon, though often a district is visited in the afternoon or evening. The usual method of collecting milk samples is as follows: The collectors go to the different districts to which they have been assigned the previous day, and begin their work very early in the morning, usually about 2 or 3 o'clock. Each carries a satchel in which are sample cans, bottles for return samples, tags for identification of the specimens collected, blank receipts, sealing wax, etc. At the time of taking a sample the collector makes a series of memoranda on a tag, which, before leaving the wagon, he affixes by means of a piece of copper wire to the handle of the sample can. The memoranda include every important point in any way connected with the taking of the milk—the name on the wagon, the license number, the name of the driver in charge, the time and exact locality, the number of cans on the wagon, the kind of can from which the sample was taken, whether the same was marked "skimmed milk," whether a sealed portion of the sample was delivered, and to whom, and any unusual or peculiar circumstances. These notes are made in the presence of the driver; and the tag, securely fastened to the sample, serves for its identification, and may later be used to refresh the memory of the collector on the witness stand in case of prosecution. In every case the person from whom the sample is taken is asked if he desires a sealed portion of the same. If the answer is in the affirmative, a 3-ounce bottle is filled, properly labeled by means of a small tag, and sealed in such a way that the latter can not be removed without breaking the seal. The collector then delivers the bottle to the person in charge, who signs a receipt for the same. As soon as the collector has obtained a sufficient number of samples he proceeds to the office, and having delivered them to the chemist, prepares to make a second trip. If, as frequently happens, he arrives at the office at such an early hour that nobody else is present, he locks his samples into a small closet, to which only himself and the chemist have keys. The second trip is made, as a rule, during the forenoon among the stores. The different districts of the city are not visited with any fixed regularity, and thus it happens that the dealers have no idea when they may next expect a visit, and hence can not feel that having been inspected to-day there will be no risk attending the conveyance of adulterated milk to-morrow. Collections are frequently made on several consecutive days in the same district by one, two, or all the collectors, and certain districts may be thus visited twice in the same morning.

A further idea of general methods may be obtained from copies of different kinds of forms used, which are shown in Appendix IV,

(pp. 187–210). They include forms for application for license, forms on which reports of dairies are made, licenses, etc. Useful suggestions regarding the supervision of market milk may be obtained from an examination of these forms.

The applicant for a license is commonly required to make a simple formal request for the privilege to sell milk. This may be on a blank form containing only a few lines. In some cases this form has printed on its face or back a few of the requirements of the ordinance, or the ordinance in full (see p. 188). In at least one city the applicant must declare that his cows and the persons in his family and in his employ are free from certain dangerous diseases, and he must agree to give prompt notice of the occurrence of disease (see p. 189). In another case the applicant must agree to numerous conditions explicitly stated (see p. 189). In a few cities the applicants must furnish a more or less detailed statement of the conditions obtaining on the dairy farms or the general conduct of the business proposed (see p. 193). The advantages of requiring such a statement before a license is granted are readily seen. Probably then, more than at any other time, special effort will be made to answer all questions satisfactorily. If the dairy is subsequently inspected and reports of conditions as found are made upon blanks like the one originally filled out, they can be conveniently compared and the differences for better or worse readily noted. It should be remembered that it is as important to give attention to facilities for handling milk after it arrives in the city as before, and forms for this kind of inspection are in use in a few places (see p. 195). Some States and several cities have special forms for use in inspecting dairies from time to time, and some of them call for many important details (see p. 196). A form upon which additions of cows to a herd must be reported is sometimes used (see p. 199).

Licenses, or permits, are usually brief, simply stating that the person or concern named is permitted to sell milk in the city, etc., until a certain time, unless the license is sooner revoked. In some cases separate licenses are issued for stores and wagons. It is not uncommon to print a part or all of the milk ordinance or regulations upon the license, thus keeping always in sight some at least of the requirements (see p. 173). A special form may be used for notifying negligent persons of the requirement that they must be registered, or licensed, and others to give notice that the license number must appear on wagons (see pp. 200 and 203).

The forms most commonly used in making inspections of milk in cities and towns are those giving data regarding the collection of milk samples and upon which prosecutions may be based (see p. 205). Special forms are also sometimes used for giving notice that a sample of milk has been taken (see p. 206); for reporting its analysis (see p. 206); for giving notice of the confiscation and perhaps spilling of condemned

milk (see p. 206); and for recording data when stores and wagons are inspected, etc. A special form is sometimes used to compel the discontinuance of the use of bottles at houses where contagious disease exists and giving permission to resume using them when the danger is past. Warnings of violations of the law are sometimes made on special forms (see p. 209). Many different methods of keeping office records are followed. In one city the "card system" appears to be used with success (see p. 210).

It should not be amiss here to mention the desirability of having as the official whose duty it is to supervise market milk one who possesses practical knowledge of the subject, as well as ability and integrity. Many such are engaged in this work, and their efforts are approved and encouraged alike by milk consumers and the better class of milk producers and dealers. It is hard to overestimate their value to the community. But, unfortunately, a few persons intrusted with this important work have wrong conceptions of their duties and sometimes they do more harm than good. The official who thinks that everyone engaged in the business of producing or selling milk is intentionally a lawbreaker, or he who constantly seeks to annoy those under his jurisdiction by petty and unreasonable requirements, does a great wrong. For the best results to all concerned, the utmost care should be taken in selecting the person who will have charge of the enforcement of milk laws.

SUGGESTIONS FOR THE IMPROVEMENT OF MARKET MILK.

Those who reported upon the milk supply were asked to mention the chief improvements which had recently come to their attention, and to suggest methods by which further improvements might be brought about. The improvements reported by the greatest number related to the dairies where milk is produced, and they showed that considerable advance has been made in the character and healthfulness of the stock, the conditions under which milch cattle are kept, and the methods of handling milk. The chief improvement shown by inspections in the cities was the decreased use of chemical preservatives in milk.

Many excellent suggestions were received regarding the improvements named and others needed, and they will be found elsewhere in connection with the separate statements for cities and towns. A few of the better ones are repeated below. Some exceedingly impracticable suggestions were also received. Naturally, the needs which are given for some places are well met in some others, yet the list includes points that might profitably be considered in every city. They are so clearly stated that comment upon them is unnecessary, and are as follows:

The registration of all dairies.
Official indorsement of properly conducted dairies.
Inspection of all herds, barns, dairy buildings, etc., once a month.
Better lighting, ventilation, drainage, and cleanliness of cow stables.
Whitewashing the interior of stables.
Eradication of tuberculosis from dairy herds.
Branding of condemned cows.
Cows not to be given swill feed, etc.
Cows to be regularly cleaned.
Pasturage for city cows.
Aeration of milk in pure air.
Prompt cooling of milk and holding it at a low temperature until final delivery.
Shipment of milk from farms promptly after milking.
Delivery of milk and cream in sealed packages (glass bottles or small cans) so as to avoid unnecessary contamination by city dust, etc.
Delivery of milk in cities at any hour of the day when it can be supplied in the best condition.
Restrictions upon the sale of milk in markets, candy stores, etc.
Delivery of milk from such stores in bottles only.
Mixing of herd milk to get an article of uniform composition.
Bottling of milk only at the dairy or place of general supply.
Daily sterilization of milk utensils.
More rigid inspections for preservatives in milk.
Chemical and bacteriological examinations of milk.
Standards for cream and skimmed milk.
The passage of no law that can not be reasonably well enforced.
More pay and allowances and greater authority for milk and dairy inspectors.
More severe penalties for violations of milk laws.
Publication of reports on inspection of dairies.
Education of milk producers by a liberal distribution of circulars, leaflets, etc., bearing upon their work.

TABLES SHOWING THE STATISTICS OF MILK SUPPLY AND SUPERVISION.

For the purpose of enabling comparison to be made between cities and towns of about the same size, such data as can be tabulated from the reports have been arranged in the four tables which follow.

TABLE I.—*Statistics of milk supply and supervision in all*

States and cities.	Population according to the 1900 census.	Average daily milk consumption.		Average daily skimmed milk consumption.	Average daily cream consumption.	Milk stores.	Milk wagons.	Farthest distance milk supplied.	Portion of milk shipped by rail.	Production of milk within city limits.			
		Total.	Per capita.							Herds.	Cows in herds.	Herds inspected past year.	
California:	*No.*	*Galls.*	*Pints.*	*Galls.*	*Galls.*	*No.*	*No.*	*Miles.*	*P.ct*	*No.*	*No.*	*No*	
Los Angeles	102,479	4,500	0.35	.....	150	.....	112	20	5	25	500	25	1
San Francisco	342,782	25,000	.58	500	1,500	173	350	.....	....	196	5,880	0	2
Colorado:													
Denver	133,859	12,110	.65	1,000	2,000	200	300	40	10	80	900	80	3
Connecticut:													
New Haven	108,027	8,750	*c*.65	.....	.....	400	200	10	....	.....	.....	....	4
Dist. of Columbia:													
Washington	278,718	12,500	.36	.....	.....	114	150	92	....	136	1,127	125	5
Illinois:													
Chicago	1,698,575	169,465	*c*.80	.....	.....	2,162	2,692	123	97	30	420	30	6
Indiana:													
Indianapolis	169,164	12,000	57	8,000	4,000	770	273	40	5	25	180	25	7
Kentucky:													
Louisville	204,731	10,000	.39	8,000	50	100	250	50	50	100	1,000	25	8
Louisiana:													
New Orleans	287,104	9,609	.27	200	75	17	410	83	11	440	6,686	440	9
Maryland:													
Baltimore	508,957	25,000	.39	5,000	4,000	2,530	525	200	....	539	3,314	539	10
Massachusetts:													
Boston	560,892	82,250	*d*1.17	.....	.....	2,900	*c*506	140	75	126	739	126	11
Fall River	104,863	6,000	.46	4	50	327	320	10	0	105	350	105	12
Worcester	118,421	16,500	*f*1.11	200	250	400	350	25	1	340	4,036	316	13
Michigan:													
Detroit	285,704	15,000	.42	2,000	700	700	230	.....	....	50	250	25	14
Minnesota:													
Minneapolis	202,718	28,000	1.11	335	3,536	400	500	75	20	.....	*g*1,300	92	15
St. Paul	163,065	12,000	.59	1,500	1,200	400	325	75	20	.....	.....	....	16
Missouri:													
Kansas City, including Kansas City, Kans	215,170	25,000	.93	.....	.....	400	420	75	20	40	700	40	17
St. Joseph	102,979	8,562	.66	4,290	100	30	125	50	12	68	1,000	12	18
St. Louis	575,238	26,375	.37	0	3,000	1,987	1,109	.....	....	400(?)	8,000	350	19
Nebraska:													
Omaha	102,555	5,740	.45	200	140	146	150	75	33	89	2,000	89	20
New Jersey:													
Jersey City	206,433	12,000	.47	0	500	450	250	250	90?	30	275	30	21
Newark	246,070	16,000	.52	.....	1,200	800	279	312	60	58	874	58	22
Paterson	105,171	8,000	.61	.....	200	225	.....	42	16	84	423	....	23

a L—Lactometer. B—Babcock test. G—Gravimetric analysis.

b Tu—Tubercle bacilli. Ty—Typhoid fever bacilli. P—Pus cells. Pa—Pathogenic bacteria.

c Portion used in manufacturing butterine.

d Large portion consumed by nonresidents for noon lunch.

the (38) cities of 100,000 or more population (Class I).

	Dairies beyond city limits supplying milk.		Retail price milk per quart.		"Model" dairies supplying milk.			Milk standard.		Milk inspection.		Examinations of milk samples past year.			
						Retail price per quart.						For composition.		For bacteria.	
	Total.	Inspected past year.	Summer.	Winter.	Number.	Summer.	Winter.	Total solids.	Fat.	Estimated annual cost.	Officials employed.	Number.	Methods.[a]	Number.	Kinds.[b]
	No.	*No.*	*Cts.*	*Cts.*		*Cts.*	*Cts.*	*P. ct.*	*P. ct.*	*Dolls.*	*No.*				
1	75	75	5	5	1	7½	7½	12	3.4	1,100	1	419	L. B. G.	.....	
2	300	0	5–7	5–7	0	.....	.....	12	3.2	.....	....	464	L. B. G.	3	Tu. Ty.
3	300	300	5–6¼	6¼–8¼	.....	.....	.....	12	3	1,200	2	2,200 600	B. G.	Few.	
4	.....	12	6	7	6	6	7	11.5	3.5	.....	....	74	L. B.	.....	
5	630	205	6–8	6–8	2	10–12	10–12	12.5	3.5	.....	3	413	L. B. G.	0	
6	4,000	11	5–7	6–7	2	7–12	7–12	12	3	10,000	7	19,053	L. B. G.	126	Tu.
7	250	204	5	6	.....	.....	.....	12	3	1,000	1	850	L. B. G.	14	
8	100	25	5–6¼	5–6¼	4	6¼–7¼	6¼–7¼	12	3	.....	3	475	G.	0	
9	69	27	7¼	7¼	3	10	10	13	3.5	.....	....	1,141	L. B. G.	2	Tu.
10	1,500	220	5–10	5–10	3	8–10	8–10	12	3	2,300	3	900 31,803	B. G. L.	300	P. Tu.
11	.....	....	5–8	5–8	20	5–8	5–8	13 12	3.7 3	13,000	6	15,000	L. B. G.	0	
12	240	240	5–6	6–7	5	7	7	12	3	1,250	1	257	B.	0	
13	568	....	5¼	5¼	25	7	8	.....	.....	1,000	3	1,400	L. B. G.	200	
14	500	....	5	6	3	7	8	12.5	3	1,000	2	1,219	L. B. G.	12	Tu. Ty.
15	.....	99	5	5–6	.....	.....	.....	13	3.5	5,000	5	3,022	B. G.	Few.	
16	.....	....	5	6	0	.....	.....	13	3.5	2,000	....	500	L. B. G.	0	
17	240	200	5	5¼	3	6	6	12	3	2,500	2	2,500	B. G.	125	Tu.
18	.....	18	5	6¼	0	.....	.....	12	3	.....	1	6	L.	0	
19	119	....	5–8	5–8	3	12¼	12¼	11.5	3	1,850	1	684	L. B.	72	Ty.
20	.....	15	5	6	.....	.....	.....	12	3	1,200	1	460	B.	.....	
21	.....	.....	6–8	7–8	0	.....	.....	.....	.....	*h* 8.	....	500	L. G.	0	
22	500	....	6	7	Few.	8 12	8–12	12	.....	2,000	3	283 3,508	L. B. G. L.	0	
23	.....	0	6–8	6–8	2	10	12	.....	.....	.....	.....	0	.....	.....	

c There are 506 licenses, but some persons run several wagons on one license.
f Portion consumed by inhabitants of near-by towns and cities.
g Besides 1,200 cows kept by private families.
h State control.
i Tourists, etc., make average population 150,000.

TABLE I.—*Statistics of milk supply and supervision in all the*

States and cities.	Population according to the 1900 census.	Average daily milk consumption.		Average daily skimmed milk consumption.	Average daily cream consumption.	Milk stores.	Milk wagons.	Farthest distance milk supplied.	Portion of milk shipped by rail.	Production of milk within city limits.			
		Total.	Per capita.							Herds.	Cows in herds.	Herds inspected last year.	
New York:	*No.*	*Galls.*	*Pints.*	*Galls.*	*Galls.*	*No.*	*No.*	*Miles.*	*P.ct*	*No.*	*No.*	*No.*	
Buffalo	352,387	31,000	0.70	10,000	.....	1,200	529	.....	....	22	340	22	2
New York	3,437,202	333,856	.78	0	4,000	12,000	4,000	350	85	5,500	23,200	560	25
Rochester	162,608	17,000	.83	.....	.....	75	275	45	67	6	90	6	2
Syracuse	108,374	10,200	.75	800	250	340	195	8	1	14	176	14	2
Ohio:													
Cincinnati	325,902	25,000	.61	.....	.....	200	200	100	25	40	1,400	40	8
Cleveland	381,768	21,490	.45	1,000	500	1,200	580	65	....	31	225	31	2
Columbus	125,560	6,397	.41	.....	.....	134	286	40	....	.....	.....	.....	2
Toledo	131,822	9,650	.59	.....	.....	221	253	80	33	41	769	41	2
Pennsylvania:													
Allegheny	129,896	5,000	.31	.....	.....	160	400	150	67	38	500	38	2
Philadelphia	1,293,697	75,000	.46	.....	.....	1,500	2,000	200	75(?)	500	5,000	500	3
Pittsburg	321,616	30,000	.75	.....	.....	1,230	425	50	90	241	.....	...	2
Scranton	102,026	7,000	.55	.....	.....	170	125	30	....	2	25	0	2
Rhode Island:													
Providence	175,597	22,000	a1.00	.....	.....	1,200	500	60	33	.....	.....	.....	2
Tennessee:													
Memphis	102,320	6,400	.50	.....	.....	40	168	527	....	.....	.....	.....	2
Wisconsin:													
Milwaukee	285,315	25,000	.70	.....	600	500	600	72	25	117	643	70	8
Average of those reporting.	375,257	30,930	.61	2,152	1,273	968	550	105	38	297	2,260	124	....

a Portion used in manufacturing butterine.

8) *cities of 100,000 or more population (Class I)*—Continued.

	Dairies beyond city limits supplying milk.		Retail price milk per quart.		"Model" dairies supplying milk			Milk standard.		Milk inspection.		Examinations of milk samples past year.			
						Retail price per quart.						For composition.		For bacteria.	
	Total.	Inspected past year.	Summer.	Winter.	Number.	Summer.	Winter.	Total solids.	Fat.	Estimated annual cost.	Officials employed.	Number.	Methods.	Number.	Kinds.
	No.	*No.*	*Cts.*	*Cts.*		*Cts.*	*Cts.*	*P. ct.*	*P. ct.*	*Dolls.*	*No.*				
	656	....	6	6	Few.	7	7	12	3	2,000	3	64 1,022	B. G. L.	3	
	3,500	....	6	8	Few.	12-15	12-15	12	3	.....	12	78,341 1,313	L. B. G.	.....	
	200	175	5	6	10	6	8	12	3	4,000	2	204 4,254	G. L. B.	335	
	216	216	5	5	40	5-8	5-8	.....	.....	1,400	1	10,630 120	L B. G.	0	
	200	150	6	6	3	8	8	12	3.1	1,200	1	600	B.	0	
	650	250	5	6	2	6	7	.....	.....	3,000	4	6,666	B.	300	Pa.
	191	....	6	6	.....	.....	.....	12 11.5	3 2.5	1,200	2	456	L. B.	Few.	Tu. Ty.
	202	131	5	6	1	8	10	12 11.5	3	1,250	1	450	G.	14	Tu.
	90	....	6	8	.....	.....	.....	.....	.....	2,700	2	2,000	L. B. G.	180	Tu. Ty.
	2,500	....	6	8	4(?)	.....	.....	12	3.5	9,580	10	95 47,023	L. G. L.	390	Ty. P.
	.....	....	6-8	8-10	4	10	10	.....	.....	3,000	2	4,997	B. G.	0	
	400	0	6	7	0	.....	.....	12.5	3.5	1,200	1	2,612	L. B.	0	
	.....	....	5-8	6-8	7	6-8	6-8	12	2.5	6,000	4	[b]3,178	B. G.	200	
	188	153	6	6	1	8	8	12	3	1,200	2	1,083	B. G.	36	Tu. Ty. P.
	.....	0	5	5-6	0	.....	.....	12	3	1,500	....	.....	B.	0	
	686	414	5.8	6.5	.....	8.2	8.6	.....	.....	2,953	3	6,834	.....	77	

[b] For five months.

TABLE II.—*Statistics of milk supply and supervision in all of the* (*40*)

States and cities.	Population according to the 1900 census.	Average daily milk consumption.		Average daily skimmed milk consumption.	Average daily cream consumption.	Milk stores.	Milk wagons.	Farthest distance milk supplied.	Portion of milk shipped by rail.	Production of milk within city limits.			
		Total.	Per capita.							Herds.	Cows in herds.	Herds inspected past year.	
California:	*No.*	*Galls.*	*Pints.*	*Galls.*	*Galls.*	*No.*	*No.*	*Miles.*	*P.ct.*	*No.*	*No.*	*No.*	
Oakland	66,960	4,500	0.54	100	75	45	80	40	....	45	3,500	45	1
Connecticut:													
Bridgeport	70,996	6,250	.70	0	250	200	250	75	8	8	.....	....	2
Hartford	79,850	9,000	[c].90	600	115	53	195	20	3	20	300	20	3
Delaware:													
Wilmington	76,508	3,756	.39	250	25	55	341	40	50	9	85	0	4
Georgia:													
Atlanta	89,872	[c]1,500	.13	300	101	10	350	20	20	3	.....	3	5
Savannah	54,244	3,000	.44	.....	.....	10	.....	5	0	.....	.....	0	6
Illinois:													
Peoria	56,100	5,000	.71	500	450	45	80	50	4	23	446	23	7
Indiana:													
Evansville	59,007	2,500	.34	.....	.....	3	60	9	0	5	60	5	8
Iowa:													
Des Moines	62,139	5,000	.64	.....	.....	40	125	40	....	75	1,000	....	9
Kansas:													
Kansas City	51,418	[g]3,000	.47	.....	165	100	75	40	....	42	1,000	42	10
Maine:													
Portland	50,145	3,000	.48	.....	.....	200	75	48	75	19	134	....	11
Massachusetts:													
Cambridge	91,886	[b]9,074	.79	202	116	410	156	100	53	76	234	76	12
Lawrence	62,559	6,000	.76	500	200	700	200	12	....	8	130	8	13
Lowell	94,969	7,700	.65	200	50	350	156	20	4	.....	100	....	14
Lynn	68,513	6,000	.70	600	125	350	75	300	67	60	350	60	15
New Bedford	62,442	7,000	.90	.....	.....	201	170	20	....	20	700	20	16
Somerville	61,643	7,640	.99	400	500	300	185	175	87	2	62	2	17
Springfield	62,059	4,750	.61	.....	.....	103	133	14	0	20	[e]130	....	18
Michigan:													
Grand Rapids	87,565	5,000	.46	500	200	51	228	100	5	.....	1,000	....	19
Minnesota:													
Duluth	52,969	4,000	.60	100	225	45	95	155	33	100	1,100	100	20
New Hampshire:													
Manchester	56,987	4,000	.56	.....	.....	100	115	18	....	0	.....	0	21
New Jersey:													
Camden	75,935	4,000	.42	125	100	128	75	30	[f]	0	.....	0	22
Elizabeth	52,130	13,062	2.00	0	.....	25	50	5	....	10	100	10	23
Hoboken	59,364	8,750	[h]1.21	.....	.....	243	24	.....	.....	.....	.....	.....	24
Trenton	73,307	4,500	.49	.....	.....	25	130	20	5	1	20	....	25

[a] S. = State control.
[b] L. = lactometer. G. = gravimetric analysis. B. = Babcock test.
[c] A portion is consumed by nonresidents.
[d] Many.
[e] Besides 2,500 gallons of buttermilk.
[f] Nearly all.

cities of over 50,000 and under 100,000 population (Class II).

	Dairies beyond city limits supplying milk.		Retail price milk per quart.		"Model" dairies supplying milk.			Milk standard.		Milk inspection.		Examinations of milk samples past year.			
												For composition.		For bacteria.	
	Total.	Inspected past year.	Summer.	Winter.	Number.	Retail price per quart. Summer.	Retail price per quart. Winter.	Total solids.	Fat.	Estimated annual cost.[a]	Officials employed.	Number.	Methods.[b]	Number.	Kinds.
	No.	*No.*	*Cts.*	*Cts.*		*Cts.*	*Cts.*	*P. ct.*	*P. ct.*	*Dolls.*	*No.*				
1	35	35	5-10	5-10	0	.....	.....	.....	3	1,200	1	250	B.	10	
2	.....	....	7	8	0	.....	.....	.....	.....	0	0	.....	.....	.....	
3	171	35	6-7	7-8	(*d*)	6-10	7-10	12.3	3.5	500	1	651	L. B.	.....	
4	200	200	6	8	0	.....	.....	12	3	1,500	2	125	L. G.	125	
5	350	(*f*)	5	6	Few.	7	9	.....	.....	.....	2	1,250	G.	0	
6	15	0	10	10	3	10	10	.....	.....	0	0	0	.....	.....	
7	78	73	5-6	5-7	0	.....	.....	12	3	1,500	2	770	B.	35	
8	54	54	6½	6½	1	6½	6½	.....	.....	900	1	215	L. B. G.	0	
9	100	....	5	5	0	.....	.....	.....	.....	S. 300	1	1,000	B.	0	
10	.....	10	5	5	0	.....	.....	12	3	100+	2	0	.....	0	
11	40	....	6	7	Few.	7	7	.....	.....	0	0	0	.....	0	
12	500	....	4-8	5-9	Few.	8	9	.....	.....	1,500	2	3,367	B. G.	.....	
13	.....	....	6	6	0	.....	.....	.....	.....	350	1	179	B.	.....	
14	.....	....	5	6	1	7	7	.....	.....	2,329	2	2,972	B. G.	.....	
15	800	....	4-7	4-7	Few.	7	7	.....	.....	2,500	2	.....	.....	.....	
16	.....	....	6	6	0	.....	.....	.....	.....	1,500	2	900	L.	0	
17	.....	....	6	7	0	.....	.....			500	1	575	B. G.	0	
18	420	....	6	6	0	.....	.....	.....	.....	100	1	.....	L. B.	.....	
19	228	228	5	6	7	6-8	6-8	12.5	3	1,600	2	1,500	B. G.	0	
20	65	45	5	6	1	7	7	.....	.....	S.	1	400	B.	0	
21	150	....	5	5-6	0	.....	.....	.....	.....	300	1	140	L.	.....	
22	113	0	8	8	0	.....	.....	.....	.....	1,200	2	550	L. G.	0	
23	55	55	6	8	0	.....	.....	.....	.....	S.	....	.....	L.	0	
24	.....	....	3-6	4-8	.....	.....	.....	.....	.....	0	.....	.....	.....	.....	
25	150	30	6	8	3	6	8	.....	.....	S.	....	100	L. G.	0	

g 4,000 gallons in addition used by oleomargarine factories.

h Also large quantities of cream and skim milk used by bakers and ice-cream manufacturers.

i Besides 100 private cows.

j Almost all.

k Wholesalers and retailers report same milk.

TABLE II.—*Statistics of milk supply and supervision in all of the (40)*

States and cities.	Population according to the 1900 census.	Average daily milk consumption.		Average daily skimmed milk consumption.	Average daily cream consumption.	Milk stores.	Milk wagons.	Farthest distance milk supplied.	Portion of milk shipped by rail.	Production of milk within city limits.			
		Total.	Per capita.							Herds.	Cows in herds.	Herds inspected past year.	
New York:	*No.*	*Galls.*	*Pints.*	*Galls.*	*Galls.*	*No.*	*No.*	*Miles.*	*P.ct*	*No.*	*No.*	*No.*	
Albany	94,151	8,022	0.68	1,468	213	105	188	62	25	25	366	....	36
Troy (and Lansingburg).	73,246	6,000	.66	750	.....	.....	120	50	12	.....	.....	...	37
Utica	56,383	5,000	.71	300	150	60	210	10	0	5	50	5	28
Ohio:													
Dayton	85,333	6,500	.61	200	150	300	100	20	50	15	194	15	29
Oregon:													
Portland	90,426	7,500	.66	.....	.....	25	150	8	0	45	240	20	30
Pennsylvania:													
Erie	52,733	3,600	.54	250	150	123	78	15	0	3	25	3	31
Harrisburg	50,167	2,500	.40	1,000	125	12	75	15	8	2	20	....	32
Reading	78,961	4,200	.43	1,400	175	20	145	8	0	0	.....	0	33
Wilkesbarre	51,721	2,890	.45	.....	.....	40	60	130	50	0	.....	0	34
South Carolina:													
Charleston	55,807	720	a.10	8	1	.....	6	5	0	.....	.....	....	35
Tennessee:													
Nashville	80,865	6,802	.67	.....	.....	13	198	18	....	0	.....	0	36
Texas:													
San Antonio	53,321	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	37
Utah:													
Salt Lake City	53,531	2,300	.34	.....	.....	20	57	35	....	25	b250	....	38
Virginia:													
Richmond	85,050	4,000	.38	.....	100	100	150	35	5	0	.....	0	39
Washington:													
Seattle	80,671	9,200	.91	400	700	142	87	44	66	21	400	21	40
Average of those reporting.	68,048	5,313	.63	423	186	128	133	48	25	21	444	18	....

a Large number of private cows kept and no record of milk sold from these.
b 1,000 gallons are produced by private cows.

es of over 50,000 and under 100,000 population (Class II)—Continued.

Dairies beyond city limits supplying milk.		Retail price milk per quart.		"Model" dairies supplying milk.			Milk standard.		Milk inspection.		Examinations of milk supplies past year.			
					Retail price per quart.						For composition.		For bacteria.	
Total.	Inspected past year.	Summer.	Winter.	Number.	Summer.	Winter.	Total solids.	Fat.	Estimated annual cost.	Officials employed.	Number.	Methods.	Number.	Kinds.
No.	*No.*	*Cts.*	*Cts.*		*Cts.*	*Cts.*	*P. ct.*	*P. ct.*	*Dolls.*	*No.*				
150	....	6	6	0	.....	.....	.....	.....	S.	....	12,000	L. B. G.	Few.	
200	....	6	6	0	.....	.....	.....	.....	S.	....	.....	.....	.....	
125	125	5	6	3	5	6	12	3	600	1	50	L. B. G.	1	
50	37	5–6	5–6	3	7	7	.....	.....	0	1	.....	.....	5	
.....	15	5	5–7½	0	.....	.....	.....	.....	S.	....	75	B. G.	0	
100	100	5	5	0	.....	.....	.....	.....	.....	....	1,758	L. B. G.	0	
90	....	5–6	6	1	7	7	.....	.....	0	0	.....	.....	0	
145	....	6	6	.....	.....	.....	.....	.....	185	1	121	L.	0	
53	53	6	8	Few.	6	8	.....	.....	.....	1	350	L. B.	.....	
.....	1	8	8	0	.....	.....	.....	.....	0	....	0	.....	27	
133	0	.....	.....	.....	.....	.....	12.5	.....	.....	....	2,570	G.	6	
.....	0	8	10	1	.....	.....	.....	.....	0	0	0	.....	0	
.....	....	5	5	2	5	5	12	3	.....	0	55	L. B. G.	.....	
150	0	6	6	0	.....	.....	.....	.....	0	0	0	.....	0	
76	76	5	7	0	.....	.....	12	3	1,200	1	2,400 117	B. G.	0	
167	64	5.9	6.6	.....	6.9	7.4	.....	.....	685	1	1,076	.....	7	

TABLE III.—*Statistics of milk supply and supervision in (83)*

States and cities.	Population according to the 1900 census.	Average daily milk consumption.		Average daily skimmed milk consumption.	Average daily cream consumption.	Milk stores.	Milk wagons.	Farthest distance milk supplied.	Portion of milk shipped by rail.	Production of milk within city limits.			
		Total.	Per capita.							Herds.	Cows.	Herds inspected past year.	
Alabama:	*No.*	*Galls.*	*Pints.*	*Galls.*	*Galls.*	*No.*	*No.*	*Miles.*	*P.ct*	*No.*	*No.*	*No.*	
Birmingham	38,415	2,000	0.42	.....	.....	2	100	50	10	20	300	20	1
Mobile	38,469	.....	.....	.....	.....	8	35	6	0	.....	.....	.....	2
Montgomery	30,346	*d* 540	.14	20	25	0	25	8	0	1	14	1	3
Arkansas:													
Little Rock	38,307	1,300	.26	.....	.....	Few.	40	12	....	25	250	....	4
California:													
Sacramento	29,282	3,000	.82	.....	50	15	55	7	....	0	.....	....	5
Colorado:													
Pueblo	28,157	5,000	*e* 1.42	350	200	10	40	20	....	20	650	20	6
Connecticut:													
New Britain	25,998	1,500	.46	50	10	0	30	.....	....	1	.....	....	7
Waterbury	45,859	5,000	.87	250	250	130	125	20	5	200	3,000	200	8
Florida:													
Jacksonville	28,429	1,200	.34	.....	.....	75	35	4	....	0	.....	....	9
Georgia:													
Augusta	39,441	*d* 600	.12	.....	.....	1	30	6	....	0	.....	....	10
Hawaii:													
Honolulu	39,306	*d* 1,000	.20	0	12	3	30	6	....	37	900	10	11
Illinois:													
East St. Louis	29,655	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	12
Joliet	29,353	2,400	.65	0	15	8	55	5	0	0	.....	....	13
Quincy	36,252	1,500	.33	1,000	500	30	20	5	....	.....	.....	....	14
Rockford *b*	31,051	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	15
Springfield	34,159	2,500	.59	.....	.....	4	48	20	6	7	63	7	16
Indiana:													
Fort Wayne	45,115	2,480	.44	.....	.....	15	106	8	0	175	297	175	17
South Bend	35,999	1,000	.22	.....	.....	0	35	15	2	0	.....	....	18
Terre Haute	36,673	1,000	.22	40	30	9	25	30	....	.....	.....	....	19
Iowa:													
Cedar Rapids	25,656	1,500	.47	400	200	35	40	12	0	8	200	....	20
Council Bluffs	25,802	1,600	.49	50	250	6	31	7	33	22	300	0	21
Davenport	35,254	1,400	.32	500	150	3	64	6	0	14	239	14	22
Dubuque	36,297	1,425	.31	.....	150	12	45	10	0	.....	.....	.....	23
Sioux City	33,111	4,500	*a* 1.09	.....	.....	10	46	6	0	41	610	0	24
Kansas:													
Topeka	33,608	2,000	.48	50	80	20	50	10	0	4	60	4	25
Kentucky:													
Covington	42,938	3,500	.65	.....	.....	140	36	9	..	0	.....	....	26
Lexington	26,369	2,000	.61	258	178	10	48	7	0	.....	.....	....	27
Newport	28,301	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	28

a S. = State control.

b L. Lactometer. B. = Babcock test. G. = Gravimetric analysis.

c Tu. = Tubercle bacilli. Ty. = Typhoid fever bacilli. P. = Pus cells. Pa. = Pathogenic bacteria. Dp. = Diphtheria.

cities of over 25,000 and under 50,000 population (Class III).

	Dairies beyond city limits supplying milk.		Retail price milk per quart.		"Model" dairies supplying milk.			Milk standard.		Milk inspection.		Examinations of milk samples past year.			
						Retail price per quart.						For composition.		For bacteria.	
	Total.	Inspected past year.	Summer.	Winter.	Number.	Summer.	Winter.	Total solids.	Fat.	Estimated annual cost.[a]	Officials employed.	Number.	Methods.[b]	Number.	Kinds.[c]
	No.	*No.*	*Cts.*	*Cts.*		*Cts.*	*Cts.*	*P. ct.*	*P. ct.*	*Dolls.*	*No.*				
1	90	40	8	9	2	9	10	12.5	3	1,000	1	500	L. B. G.	.....	
2	35	0	10	10	0	.....	.....	.....	.....	0	0	.....	.....	.....	
3	19	19	10	10	0	.....	.....	12.5	3	1,000	1	864	L. B. G.	Several.	Tu.
4	40	.....	.....	.....	.....	.....	.....	.....	.....	0	0	.....	.....	.....	
5	36	36	7	7	.....	.....	.....	12	3.2	1,300	1	1,200	B.	.....	
6	17(?)	17	6	7	.....	.....	.....	.....	.....	1,000	1	*f* 344	L. B. G.	.....	
7	30	.....	6-7	7-8	0	.....	.....	.....	.....	0	0	.....	.....	.....	
8	250	250	5	7	0	.....	.....	.....	.....	1,000	1	1,000	B. L. G.	2	Ty.
9	35	35	10	10	0	.....	.....	12	3	.....	.....	185	L. B.	.....	
10	20	0	4-6½	6½-7½	0	.....	.....	.....	.....	0	0	0	.....	0	
11	.....	.....	10-15	10-15	0	.....	.....	.....	.....	1,660	2	*f* 700	L. B. G.	0	
12	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0	.....	.....	.....	
13	40	40	5	5	0	.....	.....	.....	3	.....	.....	300	L.	.....	
14	20	.....	5	5	.....	.....	.....	.....	.....	0	0	.....	.....	.....	
15	.....	.....	.....	.....	.....	.....	.....	.....	.....	0	0	.....	.....	.....	
16	28	13	.....	.....	.....	.....	.....	12	3	.....	.....	389	L. B.	0	
17	84	84	.....	.....	.....	.....	.....	12	3.5	.....	.....	700	B.	0	
18	25	0	5	6	0	.....	.....	.....	.....	.....	.....	28	Preserv.	0	
19	24	24	5	5	1	10	10	.....	.....	1,200	1	500	B. preserv.	.....	
20	.....	0	4-5	4-5	0	.....	.....	.....	3	S. 150	.....	.....	B.	0	
21	5(?)	0	5	6	0	.....	.....	.....	.....	S.	1	.....	B.	0	
22	52	52	5	5	.....	.....	.....	.....	.....	600	2	1,000 5	B. G.	0	
23	40	0	5	5	0	.....	.....	.....	.....	S. 144	1	5,000	B.	.....	
24	.....	.....	5	6	0	.....	.....	.....	.....	S. 144	1	720	B.	0	
25	150	.....	5	5-6½	1	8½	.....	12	3	1,000	1	400	B.	0	
26	31	31	6-8	6-8	1	8	8	.....	.....	.....	.....	372	L. B.	0	
27	39	.....	5	6½	.....	.....	.....	.....	.....	0	0	.....	.....	.....	
28	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	

[d] Large number of private cows kept and milk sold; no record.
[e] Claim population is 47,955.
[f] Samples examined in 9 months.
[g] Claim population is over 35,000.
[h] No inspector and no records; can get no facts.

TABLE III.—*Statistics of milk supply and supervision in (85)*

States and cities.	Population according to the 1900 census.	Average daily milk consumption.		Average daily skimmed milk consumption.	Average daily cream consumption.	Milk stores.	Milk wagons.	Farthest distance milk supplied.	Portion of milk shipped by rail.	Production of milk within city limits.			
		Total.	Per capita.							Herds.	Cows.	Herds inspected last year.	
Massachusetts:	*No.*	*Galls.*	*Pints.*	*Galls.*	*Galls.*	*No.*	*No.*	*Miles.*	*P.ct*	*No.*	*No.*	*No.*	
Brockton	40,063	3,200	0.64	50	40	150	150	16	0	41	584	41	29
Chelsea	34,072	3,800	.89	100	40	179	46	.....	....	15	140	15	30
Fitchburg	31,531	4,541	1.15	.....	45	99	126	12	....	34	404	34	31
Gloucester	26,121	2,300	.70	0	125	124	88	16	....	50	700	50	32
Haverhill	37,175	3,290	.71	.....	.....	120	100	10	....	120	1,000	120	33
Holyoke	45,712	4,373	.77	488	63	172	136	16	....	78	858	78	34
Malden	33,664	3,000	.71	.....	.....	95	45	75	50	25	183	(a)	35
Newton	33,587	5,275	1.25	.....	32	140	130	50	4	41	1,170	41	36
Salem	35,956	4,200	.93	.....	33	80	61	12	....	6	185	....	37
Taunton	31,036	2,532	.65	.....	.....	26	135	9	0	77	810	77	38
Michigan:													
Bay City	27,628	3,000	.87	.....	.....	8	28	6	....	3	40	3	39
Jackson City	25,180	1,745	.55	.....	.....	60	52	6	....	8	56	8	40
Saginaw	42,345	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	41
Missouri:													
Joplin	26,023	3,500	.56	50	25	21	32	20	....	1	25	....	42
Montana:													
Butte	30,470	7,000	.75	1,000	100	12	35	12	4	0	.....	.....	43
Nebraska:													
Lincoln	40,169	3,000	.60	2,000	200	25	(?)	6	0	0	.....	.....	44
South Omaha	26,001	1,108	.34	30	60	2	27	30	....	4	71	4	45
New Jersey:													
Atlantic City	27,838	.....	.....	.....	.....	30	50	50	100	0	.....	.....	46
Bayonne	32,772	1,800	.50	.....	.....	130	35	40	....	4	125	4	47
Passaic	27,777	.....	.....	.....	.....	.....	.....	100	70	43	122	43	48
New York:													
Auburn	30,345	3,000	.79	50	50	4	60	6	0	5	230	....	49
Binghamton	39,647	2,520	.51	215	250	50	72	10	....	0	.....	.....	50
Elmira	35,672	5,000	1.12	.....	.....	25	100	6	....	8	170	....	51
Schenectady	31,682	2,000	.51	.....	.....	8	34	18	13	3	20	0	52
Yonkers	47,931	4,000	.67	0	40	208	56	85	50	28	648	28	53
Ohio:													
Akron	42,728	3,000	.56	.....	100	75	88	20	13	2	25	2	54
Canton	30,667	2,000	.52	.....	.....	.....	70	10	....	3	41	3	55
Springfield	38,253	.....	.....	.....	.....	.....	.....	8	....	.....	.....	.....	56
Youngstown	44,885	2,000	.36	.....	.....	45	60	15	....	0	.....	.....	57
Pennsylvania:													
Allentown	35,416	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	58
Altoona	38,973	3,500	.72	.....	.....	25	40	15	50	2	20	....	59

a Nearly all.

cities of over 25,000 and under 50,000 population (Class III)—Continued.

	Dairies beyond city limits supplying milk.		Retail price milk per quart.		"Model" dairies supplying milk.			Milk standard.		Milk inspection.		Examination of milk samples past year.			
						Retail price per quart.						For composition.		For bacteria.	
	Total.	Inspected past year.	Summer.	Winter.	Number.	Summer.	Winter.	Total solids.	Fat.	Estimated annual cost.	Officials employed.	Number.	Methods.	Number.	Kinds.
	No.	*No.*	*Cts.*	*Cts.*		*Cts.*	*Cts.*	*P. ct.*	*P. ct.*	*Dolls.*	*No.*				
29	20	20	6	6	1	6	6	.....	.....	100	....	25	.....	.....	
30	.....	....	4-7	5-8	0	.....	.....	.....	.....	225	....	1,058	Lacto-scope.	0	
31	58	0	6	6	Few.	6	6	12	3	300(?)	1	25	L.	4	Ty. Dip.
32	.....	....	6-7	6-7	.....	.....	.....	.....	.....	150	1	0	.....	.....	
33	125	39	6	6	Few.	6	6	.....	.....	150	....	275	L. B.	0	
34	300	....	5	6	Few.	7	8	.....	.....	500	2	260	B.	0	
35	.....	....	6	7	0	.....	.....	.....	.....	300	1	475	G.	0	
36	63	....	7-8	7-8	1	8	8	.....	.....	601.39	1	1,562	L. G.	.....	Tu. Ty.
37	20	....	6-7	7-8	Few.	7-8	7-8	.....	.....	S.	....	.....	.....	.....	
38	.....	....	6	6	0	.....	.....	.....	.....	50	1	7	L.	0	
39	27	27	.....	.....	.....	.....	.....	12.5	3	.....	....	[b]168	B.	0	
40	59	59	5	5	.....	.....	.....	.....	.....	.....	1	220	B. G.	0	
41	.....	....	.....	.....	.....	.....	.....	.....	.....	.....	....	.....	.....	.....	
42	22	....	5	5	5	5	5	.....	.....	S.	1	0	.....	.....	
43	35	35	10	10	.....	.....	.....	.....	.....	.....	1	350	B.	0	
44	25	0	7	8	4	7	8	.....	.....	0	....	0	.....	.....	
45	22	22	5-6	6	2	6	6	12	3	1,000	1	411	L. B. G.	0	
46	.....	....	8	8	Few.	8	8	.....	.....	S.	....	.....	.....	.....	
47	.....	....	.....	.....	.....	.....	.....	12	3	.....	....	0	.....	.....	
48	.....	0	5-8	5-8	1	.....	.....	.....	.....	.....	1	.....	L.	0	
49	50	....	5	5	.....	.....	.....	.....	.....	.....	....	160	B.	0	
50	.....	....	5	5	Few.	5-6	5-6	.....	.....	0	0	.....	.....	6	
51	150	150	5	5	4	5	5	.....	.....	.....	1	.....	L.	0	
52	.....	0	5	6	0	.....	.....	.....	.....	.....	....	500	L.	0	
53	54	6	5-7	6-7	3	8-10	8-10	12	3	2,500	2	123	G.	43	P.
54	60	54	5	6	0	.....	.....	.....	.....	300	1	580	L. and lacto-scope.	0	
55	.....	....	5	5	.....	.....	.....	.....	.....	700	2	.....	L.	.....	
56	.....	....	5-6	5-6	2	6	6	.....	.....	.....	0	.....	.....	.....	
57	40	0	6	8	Few.	6	8	.....	.....	100	1	109	B.	12	
58	.....	....	6	6	.....	.....	.....	.....	.....	.....	....	40	.....	.....	
59	.....	....	6	7	.....	.....	.....	.....	.....	S.	....	36	.....	0	

[b] Samples examined in 9 months.

TABLE III.—*Statistics of milk supply and supervision in (83)*

States and cities.	Population according to the 1900 census.	Average daily milk consumption.		Average daily skimmed milk consumption.	Average daily cream consumption.	Milk stores.	Milk wagons.	Farthest distance milk supplied.	Portion of milk shipped by rail.	Production of milk within city limits.			
		Total.	Per capita.							Herds.	Cows.	Herds inspected past year.	
Pennsylvania—Ctd	*No.*	*Galls.*	*Pints.*	*Galls.*	*Galls.*	*No.*	*No.*	*Miles.*	*P.ct*	*No.*	*No.*	*No.*	
Chester	33,988	1,625	0.38	600	.....	28	59	10	6	.....	.....	.....	60
Easton	25,238	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	61
Johnstown	35,936	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	62
Lancaster	41,459	1,800	.35	.....	50	12	96	14	3	28	58	28	63
McKeesport	34,227	2,000	.47	.....	.....	.....	50	5	....	15	30	....	64
Newcastle	28,339	700	.20	150	150	75	75	7	0	0	.....	.....	65
Williamsport	28,757	875	.24	.....	.....	14	90	50	14	4	25	4	66
York	33,708	1,350	.32	150	25	25	40	8	0	0	.....	.....	67
Rhode Island:													
Pawtucket	39,231	2,955	.60	75	.....	80	125	5	2	0	.....	.....	68
Woonsocket[a]	28,204	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	69
Tennessee:													
Chattanooga[a]	30,154	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	70
Knoxville	32,637	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	71
Texas:													
Dallas	42,638	5,250	.98	.....	.....	3	175	8	0	0	.....	.....	72
Fort Worth[a]	26,688	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	73
Galveston[a]	37,789	.....	.....	.....	.....	.....	.....	29	10	10	50	8	74
Houston	44,633	3,800	.68	100	200	3	109	6	0	19	269	19	75
Virginia:													
Norfolk[a]	46,624	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	76
Washington:													
Spokane	36,848	2,500	.54	.....	200	8	45	50	....	6	200	6	77
Tacoma[a]	37,714	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	78
West Virginia:													
Wheeling	38,878	4,000	.82	.....	400	140	120	30	33	10	100	....	79
Wisconsin:													
La Crosse	28,895	1,000	.28	100	100	50	30	2	0	.....	.....	.....	80
Oshkosh	28,284	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	81
Racine	29,102	1,800	.49	100	50	20	40	8	0	0	.....	.....	82
Superior	31,091	.....	.....	.....	.....	2	40	140	....	27	400	27	83
Average of those reporting.	34,216	2,608	.58	265	118	46	64	20	12	21	355	31	....

[a] No inspectors and no records; can get no facts.

ities of over 25,000 and under 50,000 population (Class III).—Continued.

	Dairies beyond city limits supplying milk.		Retail price milk per quart.		"Model" dairies supplying milk.			Milk standard.		Milk inspection.		Examinations of milk samples past year.			
						Retail price per quart.						For composition.		For bacteria.	
	Total.	Inspected past year.	Summer.	Winter.	Number.	Summer.	Winter.	Total solids.	Fat.	Estimated annual cost.	Officials employed.	Number.	Methods.	Number.	Kinds.
	No.	*No.*	*Cts.*	*Cts.*		*Cts.*	*Cts.*	*P. ct.*	*P. ct.*	*Dolls.*	*No.*				
60	70	....	6	8	.....	.....	.....	.....	.....	.....	0	.....	.....	.....	
61	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
62	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
63	145	80	5-6	5-6	10	5-6	5-6	.....	.....	8	0	505	L. B.	.....	
64	12	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0	.....	0	
65	75	0	6	7	.....	.....	.....	0	.....	0	0	0	.....	0	
66	127	127	5	6	3	5	6	.....	.....	.....	1	73	L. Cr. gauge.	0	
67	28	0	5	5	0	.....	.....	.....	.....	0	0	0	.....	0	
68	200	1	5-6	6-7	2	7	7	.....	.....	400	1	300	L. G.	0	
69	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
70	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0	.....	.....	.....	
71	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
72	150	150	4-5	4-5	.....	.....	.....	.....	.....	.....	.....	.....	L.	.....	
73	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0	.....	.....	.....	
74	.....	0	15	15	.....	.....	.....	.....	.....	0	0	0	.....	0	
75	128	128	5	5	0	.....	.....	12	3.2	960	1	4,775	L. B.	0	
76	.....	.....	.....	.....	.....	.....	.....	.....	.....	0	0	.....	.....	.....	
77	.....	0	6	8	0	.....	.....	.....	.....	.....	.....	650	B.	.....	
78	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	206	B.	.....	
79	125	....	6	8	0	.....	.....	.....	.....	.....	0	.....	.....	.....	
80	16	....	5	5	1	6	6	.....	.....	0	0	.....	.....	.....	
81	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
82	50	0	5	5	.....	.....	.....	.....	.....	0	....	10	L. B.	0	
83	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
....	65	37	6.2	6.7	.....	6.8	7	.....	.....	421	1	521	.....	2	

TABLE IV.—*Statistics of milk supply and supervision in (39)*

States and cities.	Population according to the 1900 census.	Average daily milk consumption.		Average daily skimmed milk consumption.	Average daily cream consumption.	Milk stores.	Milk wagons.	Farthest distance milk supplied.	Portion of milk shipped by rail.	Production of milk within city limits.			
		Total.	Per capita.							Herds.	Cows in herds.	Herds inspected past year.	
California:	*No.*	*Galls.*	*Pints.*	*Galls.*	*Galls.*	*No.*	*No.*	*Miles.*	*P.ct*	*No.*	*No.*	*No.*	
Alameda	16,464	1,760	0.86	50	100	21	38	45	9	11	62	11	1
San Jose	21,500	2,512	[d].93	.....	.....	40	100	7	0	3	40	3	2
Colorado:													
Colorado Springs	21,085	1,800	.68	300	80	19	28	14	....	1	60	1	3
Trinidad	5,345	500	.75	.....	.....	0	10	3	0	0	.....	.....	4
Illinois:													
Aurora	24,147	1,500	.50	100	50	14	43	8	0	2	40	2	5
Evanston	19,259	1,500	.62	.....	.....	10	40	75	35	7	400	7	6
Moline	17,248	577	.27	.....	.....	1	34	10	....	1	30	....	7
Ottawa	10,588	600	.45	.....	.....	0	15	4	....	3	25	3	8
Indiana:													
Richmond	18,226	1,250	.55	.....	.....	15	39	6	....	4	45	4	9
Iowa:													
Burlington	23,201	1,600	.55	.....	.....	1	44	20	....	50	1,200	35	10
Clinton	22,698	1,000	.35	.....	60	10	30	10	....	.....	.....	.....	11
Keokuk	14,641	500	.27	30	50	20	16	4	0	.....	.....	.....	12
Marshalltown	11,544	800	.55	100	20	1	14	3	....	2	35	....	13
Ottumwa	18,197	606	[f].27	15	12	1	18	10	8	1	[g]12	0	14
Maine:													
Belfast	4,615	300	.52	20	5	6	12	8	0	5	125	....	15
Lewiston	23,761	1,800	.61	.....	.....	10	75	5	....	25	.....	15	16
Waterville	9,477	800	.68	100	50	15	39	8	0	8	75	8	17
Massachusetts:													
Melrose	12,962	800	.49	25	20	49	69	10	5	40	150	....	18
North Adams	24,200	2,000	.66	75	25	10	50	9	0	27	377	27	19
North Attleboro	7,253	885	.98	.....	.....	6	34	4	0	24	275	24	20
Wakefield	9,290	800	.68	.....	.....	93	54	35	12	83	343	83	21
Woburn	14,254	1,032	.58	.....	.....	16	30	5	....	.....	.....	....	22
Michigan:													
Battlecreek	18,563	1,400	.60	.....	.....	4	26	9	....	6	.....	6	23
Lansing	16,485	1,000	.49	100	25	3	22	4	....	3	32	3	24
New Jersey:													
Montclair	13,962	860	.49	.....	.....	12	32	400	20	4	35	4	25
New Brunswick	20,006	1,250	.50	.....	.....	30	30	6	....	5	70	2	26
New York:													
Lockport	16,581	900	.43	25	20	30	24	6	0	2	14	2	27
Mount Vernon	21,228	3,000	[h]1.18	0	350	15	60	75	33	10	100	10	28
Rome	15,343	1,000	.52	.....	.....	4	26	6	....	3	65	3	29
Watertown	21,696	2,400	.88	750	150	15	40	7	0	14	.....	14	30

[a] S=State control.

[b] L Lactometer. B=Babcock test. G Gravimetric analysis.

[c] Tu Tubercle bacilli. Ty Typhoid bacilli. B'd corp.=blood corpuscles.

[d] 3,768 gallons brought to city daily, but about one-third goes to suburbs not included in the population of San José.

s and towns of less than 25,000 population (Class IV).

Dairies beyond city limits supplying milk.		Retail price milk per quart.		"Model" dairies supplying milk.			Milk standard.		Milk inspection.		Examinations of milk samples past year.			
					Retail price per quart.						For composition.		For bacteria.	
Total.	Inspected past year.	Summer.	Winter.	Number.	Summer.	Winter.	Total solids.	Fat.	Estimated annual cost. *a*	Officials employed.	Number.	Methods. *b*	Number.	Kinds. *c*
No.	*No.*	*Cts.*	*Cts.*		*Cts.*	*Cts.*	*P. ct.*	*P. ct.*	*Dolls.*	*No.*				
23	23	6½	6½	5	7½	8½	12.5	.....	1,200	1	925	L. B. G.	20	Bd. corp.
127	127	5	5	Few.	5	5	13	3¼	600	1	.....	B.	0	
17	8	*e* f 5–8½	*e* f 5–8½	3	6½	6½	12	3	.....	1	175	G.	3	Ty. Tu.
.....	....	6½	6½	0	.....	.....	12	3	.....	....	8	B. L. G.	0	
100	0	5	5	1	12	12	12	3	300	1	314	B. L.	15	Tu.
37	25	6	7–10	2	8	10	13	3	.....	2	40	B. L. G.	0	
30	24	5	5	0	.....	.....	.....	.....	.....	....	332	B.	.....	
13	11	5	6	0	.....	.....	.....	.....	400	1	13	B. L.	0	
36	36	5	5	Few.	5	5	.....	.....	150	1	38	B.	.....	
12	0	5	6	0	.....	.....	.....	.....	S.	....	600	B.	0	
30	....	5	5	0	.....	.....	.....	.....	S.	....	4,000	B.	.....	
.....	....	5	6¼	0	.....	.....	.....	.....	S. 126	....	432	B.	0	
12	....	4–5	5–6	0	.....	.....	.....	.....	S. 110	....	500	B.	.....	
20	1	5	6	0	.....	.....	.....	.....	S.	....	576	B.	1	Ty.
30	30	5	6	0	.....	.....	.....	.....	50	1	150	B. L. G.	0	
50	10	6	6	0	.....	.....	.....	.....	200	1	300	B. L. G.	0	
39	39	5	6	4	5	6	.....	.....	100	1	160	B. L.	0	
25	....	5–7	5–7	6	7	7	.....	.....	100	1	36	L. G.	0	
75	75	5	6	Few.	5	6	.....	.....	100	2	300	B.	0	
8	....	6	6	0	.....	.....	.....	.....	200	1	150	B.	0	
.....	....	6	6	Few.	7	7	.....	.....	150	....	154	B. G.	0	
.....	....	6	6	0	.....			.....	100	....	25	L. G.	.....	
70	70	5	5	.....	.....		12.	3	130	1	560	B. L.	.....	
45	45	5	5	.....	.....			.....	900	1	41	B. L.	4	Tu.
24	24	7–12	7–12	6	8–12	8–12		.....	300	2	166	B. L. G.	166	
55	....	4–6	5–8		6	8		.....	S.	....	3,500	B.	.....	
22	12	5	6		.....	.....	.....	.....	S.	....	40 1,000	B. L.	0	
90	90	7–15	8–15		8–15	8–15	12	3	500	....	40	L. B. G.	275	Ty.
36	36	4	5	0	.....	.....	.....	.....	400	1	106	L. B.	.....	
37	37	5	5	.....	.....	.....	.....	.....	750	2	850	L. B. G.	0	

e Pasteurized.

f Large number of people keep private cows, and some sell milk to neighbors.

g There are also about 200 cows kept by private families.

h Large amount used in institutions, population of which is not counted in the city.

TABLE IV.—*Statistics of milk supply and supervision in (39)*

States and cities.	Population according to the 1900 census.	Average daily milk consumption.		Average daily skimmed milk consumption.	Average daily cream consumption.	Milk stores.	Milk wagons.	Farthest distance milk supplied.	Portion of milk shipped by rail.	Production of milk within city limits.			
		Total.	Per capita.							Herds.	Cows in herds.	Herds inspected past year.	
Ohio:	*No.*	*Galls.*	*Pints.*	*Galls.*	*Galls.*	*No.*	*No.*	*Miles.*	*P.ct*	*No.*	*No.*	*No.*	
Fostoria	7,730	400	.41	25	10	10	8	3	....	1	125	1	31
Hamilton	23,914	1,027	.34	.....	.....	46	32	6	0	21	73	13	32
Warren	8,529	645	.60	20	20	1	11	15	3	1	24	1	33
Pennsylvania:													
Lebanon	17,628	1,500	.68	200	300	.....	45	8	0	15	60	12	34
Meadville	10,291	875	.68	.....	.....	2	30	4	....	.....	.....	....	35
Phoenixville	9,196	725	.63	30	10	3	37	5	....	7	60	....	36
Wisconsin:													
Green Bay	18,684	600	[a].26	.....	60	1	28	8	0	8	120	8	37
Marinette	16,195	464	[a].23	.....	12	3	23	96	10	8	[b]105	8	38
Waukesha	7,419	395	.43	.....	.....	.....	15	3	0	2	40	....	39
Average of those reporting.	15,728	1,112	.57	109	68	15	34	25	6	12	136	11	....

[a] Large number of people keep private cows, and some sell milk to neighbors.

ities and towns of less than 25,000 population (*Class IV*)—Continued.

	Dairies beyond city limits supplying milk.		Retail price milk per quart.		"Model" dairies supplying milk.			Milk standard.		Milk inspection.		Examinations of milk samples past year.			
						Retail price per quart.						For composition.		For bacteria.	
	Total.	Inspected past year.	Summer.	Winter.	Number.	Summer.	Winter.	Total solids.	Fat.	Estimated annual cost.	Officials employed.	Number.	Methods.	Number.	Kinds.
	No.	*No.*	*Cts.*	*Cts.*		*Cts.*	*Cts.*	*P. ct.*	*P. ct.*	*Dolls.*	*No.*				
31	6	6	5	6	2	6	7	.....	.....	200	1	108	L. B. G.	3	
32	26	16	6	6	0	.....	.....	.....	.....	.....	....	162	L. B. G.	2	Tu.
33	16	16	5	5	5	5	5	.....	.....	0	....	2 123	G. B.	0	
34	60	0	6	6	0	.....	.....	.....	.....	100	....	70	B.	0	
35	30	30	6	6	0	.....	.....	12.5	3.5	200	1	976	L. B.	0	
36	55	8	5	5	.....	.....	.....	12.5	3	100	....	496	L.	.....	
37	.....	20	5	5	0	.....	.....	12	3	.....	....	12	L. B. G.	0	
38	15	15	5	6	0	.....	.....	12	3	.....	1	82	L. B.	0	
39	13	....	6	6	.....	.....	.....	.....	.....	150	1	350	L. B.	3	Tu.
....	38	29	5.6	6	.....	7.1	7.6	.....	.....	282	1	471	.....	16.4	

[b] There are also about 200 cows kept by private families.

TABLE V.—*State standards for milk, skimmed milk, and cream.*

States.	Milk.				Skimmed milk.				Cream.
	Total solids.	Solids not fat.	Fat.	Specific gravity.	Total solids.	Solids not fat.	Fat.	Specific gravity.	Fat.
	Per ct.	*Per ct.*	*Per ct.*		*Per ct.*	*Per ct.*	*Per ct.*		*Per ct.*
District of Columbia		9	3.5		9.3				20
Georgia		8.5	3.5			8.5	3.5		
Illinois[a]	12		3						[b]15
Indiana		9	3						
Iowa	12.5		3						15
Kentucky	12		3						15
Maine	12		3						
Maryland	12.5		3.5						
Massachusetts	13	9.3	3.7			9.3			
April-September	12	9	3						
Michigan	12.5		3	1.029–1.033				1.032–1.037	
Minnesota	13		3.5						20
Montana[c]	12		3	1.025					
Nebraska			3						15
New Hampshire	13	9.5	3.5						
April-September	12	9	3			9			
New Jersey	12								
New York[d]	12		3						
North Dakota	12		3						15
Ohio[d]	12		3						
May-June	11.5								
Oregon	12	9	3						
Pennsylvania[e]	12.5		3	1.029–1.033			[f]2.5	1.032–1.037	
Rhode Island	12		2.5						
South Carolina		8.5	3						
Utah						9			
Vermont	12.5	9.25	[g]4						
May-June	12								
Washington		8	3						18
Wisconsin			3						

[a] Condensed milk shall be made from milk containing at least the legal standard of 3 per cent butter fat and evaporated to one-third or less of its original volume.

[b] Coffee cream shall contain at least 15 per cent of fat, and whipping cream 22 per cent fat.

[c] Applies to cities with a population over 5,000.

[d] In New York and Ohio the milk solids of condensed milk shall be in quantity the equivalent of 12 per cent of milk solids in crude milk, of which solids 25 per cent shall be fat.

[e] Milk and skimmed milk standards refer to cities of second and third class.

[f] Six per cent cream by volume.

[g] As basis for payment at factories.

SHORT STATEMENTS REGARDING THE MILK SUPPLY OF CITIES AND TOWNS.

In the following pages are given briefly and in narrative form such statistical and other general information as it has been possible to collect in the course of this inquiry regarding the milk supply of every one of the 161 cities in the United States having a population of over 25,000,

according to the census for 1900, and of 39 others selected from the large number of smaller cities and towns. The data thus given show, therefore, the conditions as reported by 200 representative cities and towns in the United States.

The cities and towns of each State are grouped together in the order of their size; and those in each group are preceded by a general account for the entire State whenever there are facts of interest which apply to the State as a whole. This latter includes an abstract of State laws relating to milk, and a few words to show what has been done under these laws by the State authorities.

The statement for each city and town includes the following information, or so much of it as has been obtainable: First, the name and title of the official most closely connected with the supervision of the milk supply; second, general statistics—the amount of milk used, the way it is handled, the prices for which the producers and retailers sell it, and the number and location of herds supplying it; third, an abstract of the local ordinances, regulations, etc., relating to the milk supply (care has been taken to give in considerable detail the requirements of the milk ordinances in all cities of Class I, but in others many of the ordinary requirements are omitted or barely referred to); fourth, a summary of the work done by the authorities in the supervision of the milk supply—the amount of money expended for this purpose, the number of officials employed, and numbers of inspections of dairies, and chemical and bacteriological examinations of milk; fifth, mention of a few ways in which recent improvement of the milk supply has been shown, if at all, and suggestions for further improvement; and, sixth, additional matter of interest, whenever supplied, such as the results of special investigations. With very few exceptions, every statement is based wholly upon reports received from the official named in connection with it.

ALABAMA.

This State has no milk law.

Mobile. (Population, 38,469.)

[For comparison with other cities in Class III, see p. 34.]

D. T. Rogers, clerk of the board of health.

Milk is sold from 8 stores and 35 wagons. A portion of the milk is delivered in glass bottles, which are filled at the farms. The retail price is 10 cents per quart throughout the year. There are no "model dairies" near the city. Milk is supplied from 35 dairy farms, all within a radius of 6 miles.

The city has no milk ordinance and exercises no supervision over its milk supply.

Birmingham. (Population, 38,415.)

[For comparison with other cities in Class III, see p. 34.]

W. B. Fleming, chief inspector of meat and milk.

The estimated daily consumption of milk is 2,000 gallons, or an average of 0.42 pint per capita. Milk is sold from 2 stores and 100 wagons. About 50 per cent of

the milk is delivered in glass bottles, which are usually filled at the farms. The retail price of milk is 8 cents per quart in summer and 9 cents in winter. The milk from 2 "model dairies" is sold for 9 cents per quart in summer and 10 cents in winter. Within the city limits there are 20 herds, including 300 cows, and milk is sent in from 90 dairy farms. About 10 per cent is received by railway, the longest shipment being 50 miles.

An ordinance adopted in September, 1899, regulates the sale of milk in the city. License for supplying milk is as follows: For 10 or fewer cows, $5; over 10 cows, $10; but private families keeping not more than 2 cows may sell the surplus milk to their neighbors without license. Adulterated, etc., milk is prohibited. Cows producing milk for the city must be tested with tuberculin. The milk standard is 12.5 per cent solids, 3 per cent fat, and a specific gravity at 60° F. between 1.029 and 1.033. Skimmed milk must contain 9 per cent milk solids not fat.

One thousand dollars is expended annually in the supervision of the city milk supply, one milk inspector giving his entire time to this work. In the past three months 500 samples were examined by lactometer, Babcock test, and gravimetric analysis; all the city herds and 40 of the 90 dairy farms were inspected.

The inspector states that better sanitary conditions should obtain at dairies, and more care should be exercised in feeding milch cows.

Montgomery. (Population, 30,346.)

[For comparison with other cities in Class III, see p. 34.]

W. L. Stewart, milk inspector.

John L. Harley, clerk of the sanitary department.

The amount of milk sold daily is estimated as 540 gallons, or 0.14 pint per capita, besides 20 gallons of skimmed milk and 25 gallons of cream. In explanation of this low consumption of milk, it is stated that nearly half of the families in the city keep their own cows and sell milk. This milk is not included in the above estimate. Milk is sold from no stores, but from 25 wagons. Only a limited quantity of milk is delivered in glass bottles, and these are filled at the farms. None is pasteurized. The retail price of milk is 10 cents per quart throughout the year, the producers selling direct to the consumers. No dairy near the city is conducted in an entirely satisfactory manner. Milk is supplied from one herd of 14 cows within the city limits, and 19 herds (537 cows) on farms within a radius of 8 miles.

Milk ordinances adopted in September, 1896, regulate the sale of milk. All persons selling or supplying milk must take out an annual license, at the rate of $5 for 10 cows or under, and $10 for any number exceeding 10 cows, but persons who keep not more than 2 cows for family use and sell the surplus milk to neighbors are exempt from license. Adulterated, etc., milk is prohibited. Cows producing milk to be used in the city must be free from dangerous disease, and must be tested with tuberculin. The milk standard is 12.5 per cent solids, 3 per cent fat, and specific gravity at 60° F. between 1.029 and 1.033. Skimmed milk standard is 9 per cent milk solids not fat.

One thousand dollars is expended annually in the supervision of the milk supply. A milk chemist and inspector gives his entire time to this work. During the past year 864 samples of milk were examined by lactometer, Babcock test, and gravimetric analysis, besides tests for coloring matter and preservatives; several examinations were made for tubercle bacilli. The cows at 17 dairy farms were tested with tuberculin, and all dairies were examined once a month as to sanitation, food, manner of handling milk, etc.

Recently there has been an improvement in the character of the milk supply and in the sanitary condition of dairies. It is believed that more sanitary dairy buildings are needed.

ARIZONA.

This Territory has no milk law.

ARKANSAS.

This State has no milk law.

Little Rock. (Population, 38,307.)

[For comparison with other cities in Class III, see p. 34.]

R. B. Christian, secretary of the State board of health.

The amount of milk sold daily is about 1,300 gallons, or 0.26 pint per capita. In explanation of this small consumption of milk, it is stated that a large proportion of the city families keep their own milch cows, whose product is not included in the above figures. Milk is sold from a few stores and about 40 wagons. Within the city there are 25 herds, including 250 cows, and milk is sent in from 40 dairy farms, the most distant being 12 miles from the city.

The city has no milk ordinance and exercises no supervision over its milk supply.

CALIFORNIA.

J. M. Thomas, agent and secretary of the State dairy bureau, San Francisco.

Statutes of 1899—chapter 136 refers to milk. No person shall sell impure milk or cream, or milk that is from cows fifteen days before or five days after parturition, or milk from cows that are diseased or fed unwholesome food. It is the duty of the State dairy bureau to inspect any dairy complained of as having diseased cows or being in an insanitary condition, and the bureau may require changes at places inspected. The State veterinarian may order the slaughter of diseased animals at the expense of owners. County district attorneys shall prosecute offenders.

Statutes and amendments to the Codes, extra session, 1900–1901, page 324: The use of incorrect glassware, Babcock testers, etc., in determining the richness of milk or cream as a basis for payment therefor is prohibited.

The State exercises no supervision over the milk supply of cities.

San Francisco. (Population, 342,782.)

[For comparison with other cities in Class I, see p. 26.]

Adolph Sutro, president of the board of health.

The daily consumption of milk is estimated as 25,000 gallons, or 0.58 pint per capita. It is estimated, also, that the city consumes daily 500 gallons of skimmed milk and 1,500 gallons of cream. Milk is sold from 173 stores and 350 wagons. Glass bottles are used by large dealers in the delivery of about one-fourth of the total milk supply; they are filled in the city. Practically no pasteurized milk is used. The retail price of milk is 5 to 7 cents per quart throughout the year, the producers receiving 2 to 3 cents. There are no dairies near the city which could be classed as "model dairies." Within the city there are 196 herds, including 5,880 cows, and milk is sent into the city from 300 dairy farms, the longest shipment being 60 miles.

The milk ordinance of January, 1896, gives authority to the board of health to regulate the milk supply. Some of the principal requirements of the ordinance and regulations are as follows: Each person selling milk in the city must have a permit. This is issued without cost by the board of health only after certain detailed information regarding the source of the milk and the conduct of the proposed business has been filed; it is revocable for cause. A permit is required for every place where milk is sold. Each person holding a permit must file at least once a year a detailed statement containing data similar to that in the application. Permit number shall

be prominently displayed wherever milk is sold. The ordinance forbids the sale of impure, etc., milk, including milk from cows fifteen days before or five days after calving; milk from cows given unwholesome food or water, or kept in insanitary condition, or affected with disease; milk to which any water or other substance has been added, or from which any cream has been removed; milk that is drawn from cows or by milkers that are unclean; and milk containing less than 12 per cent solids, or 3.2 per cent fat. Swill, garbage, or milk diluent must not be carried in delivery wagons. The board of health must occasionally have inspected all dairies from which milk is brought into the city. Owners of dairies must report conditions which might render milk impure. The sale of condensed milk, buttermilk, or sour milk is permitted if from pure milk; the proportion of solids in condensed milk must be equivalent to 12 per cent solids in crude milk and 26.5 per cent of them must be fat. Market inspectors are required to visit, twice a month, all dairies in the city and county and they are requested to visit milk ranches at least once a month. In certain parts of the city no person may keep more than 2 cows.

The ordinance section concerning carrying swill on milk-delivery vehicles is given in Appendix I (p. 180).

The city makes no special appropriation for the supervision of its milk supply, nor is any officer designated to give his entire time to this work. During the past year 464 samples of milk were examined for specific gravity and fat by lactometer and Babcock test, checks being occasionally made by the Westphal balance, butyro-refractometer, and gravimetric analysis; 3 samples were examined bacteriologically—2 for tubercle and 1 for typhoid bacilli; none of the city dairies or dairy farms sending milk to the city have been inspected.

It is not stated that the milk supply has recently shown any marked improvement. Liberality in providing funds for the health department to carry on a thorough inspection of dairies is recommended. It is also urged that milk users be more particular as to the character of the milk delivered to them.

Los Angeles. (Population, 102,479.)

[For comparison with other cities in Class I, see p. 26.]

George W. Hood, milk inspector.

The amount of milk sold daily is estimated as 4,500 gallons, or 0.35 pint per capita, besides 150 gallons of cream and a very small amount of skimmed milk. These figures do not include the milk produced by town cows and not sold, hence the average daily consumption is greater than 0.35 pint per capita. Milk is sold in nearly all grocery stores and in many of the fruit stores, and is served from 112 wagons. Glass bottles are used largely in the delivery of milk, being filled only at the dairies. It is estimated that about 1,000 gallons of milk is pasteurized daily, the practice having increased since the use of formalin was stopped. The retail price of milk is 5 cents per quart, both summer and winter, and the price paid the producer is just half that amount. There is only one "model dairy," which receives 7½ cents per quart throughout the year for its product. Within the city limits there are 25 dairy herds, including about 500 head. Milk is sent into the city from 2,000 cows, on about 75 dairy farms. About 5 per cent of the milk supply is received by rail, the longest shipment being 20 miles.

City milk ordinance (No. 6492), adopted in March, 1901, requires all milk or cream dealers to have an annual permit, granted by the board of health free of charge. Dairies, cows, cow stables, milk houses, milk vessels, and vehicles, whether within the city limits or not, must be subject to inspection by a board of health officer. Milk must be reduced to 60° F. before it is put into closed cans or marketed, and delivery wagons must be covered during the months of May to September. Bottling must be done at the milk houses and not upon the delivery wagons. The

delivery of bottled milk to any dwelling where there is a contagious disease is prohibited. The milk standard is as follows: Specific gravity, 1.03; butter fat, 3.4 per cent; total solids, 12 per cent; cream by volume, 9 per cent. Cream standard, butter fat 20 per cent. Skimmed milk may be sold if plainly labeled. Milk is prohibited from cows fed on any garbage or other improper food, or kept in an unsanitary condition.

In 1899 a resolution was adopted by the board of health prohibiting the delivery of milk in bottles. This resolution was passed because of the practice of refilling the glass jars in delivery wagons or elsewhere, without having the jars properly cleansed, thereby making it possible for contagious diseases to be conveyed and milk to be otherwise contaminated. The length of time this rule was in effect is not given.

The annual expenditure for the supervision of the city milk supply is about $1,100, one inspector giving his entire time to this work. During the year 419 samples of milk were examined by lactometer and the Babcock test; a part of them also for formalin. All dairy farms and all cows from which milk is used have been inspected. A detailed statement of the work performed by the milk inspector in the year ending November 30, 1899, is as follows:

Inspections of dairies, ranches, and milk depots	1,782
Samples of milk tested	765
Cows condemned (tuberculosis)	6
Cows tested (tuberculosis)	6
Complaints sworn to	10
Arrests	10
Convictions	8
Acquittals	1
Cases pending	1

The general average percentage of butter fat in samples tested this year was 3.6. Samples from hotels and restaurants averaged only 2.8, while those from dairy wagons averaged 3.7.

The form for dairyman's permit to sell milk, and stub for same, is shown in Appendix IV (p. 201).

Recent improvements in the quality of milk are due to the decreased use of preservatives and a better sanitary condition of the dairy premises. A more thorough inspection of the cattle, dairies, and milk, and a more rigid enforcement of the ordinances, would bring about further improvement.

Oakland. (Population, 66,960.)

[For comparison with other cities in Class II, see p. 30.]

Fred E. Pierce, D. V. S., market, meat, and milk inspector.

The daily consumption of milk is estimated as 4,500 gallons, or 0.54 pint per capita, besides about 100 gallons of skimmed milk and 75 gallons of cream. Milk is sold from 45 stores and 80 wagons. Glass bottles, filled in the city depots, are used in the delivery of only a very small portion of the milk supply. The practice of pasteurizing milk has been discontinued. The retail price of milk varies during the year from 5 cents to 10 cents per quart, producers receiving 3 to 3½ cents throughout the year. About 3,500 cows, in 45 city herds and 35 country herds, furnish the city with milk. A very small portion of the milk supply is received by railway, the longest shipment being 40 miles.

Ordinance No. 1618, July, 1894, refers to milk. Persons selling milk must be registered. Impure, adulterated, etc., milk is prohibited. The milk standard is 3 per cent fat. Skimmed milk must be labeled.

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About $1,200 is expended annually in the supervision of the milk supply, one inspector giving the greater part of his time to this work. During the past year 250 samples of milk were examined by the Babcock test, 10 samples were examined bacteriologically, and all the city herds and all the dairy farms were inspected.

Recent improvement has been made in the sanitary condition of the dairies. The enactment and enforcement of measures to require cleanliness in the production of milk is given as an important need.

Sacramento. (Population, 29,282.)

[For comparison with other cities in Class III, see p. 34.]

H. L. Nichols, M. D., health officer.

The daily consumption of milk is estimated as 3,000 gallons, or 0.82 pint per capita, besides 50 gallons of cream. Milk is sold from 15 stores and 55 wagons. Glass bottles are used to a small extent (mostly for cream), and they are filled both in the city and at the farms. Very little milk is pasteurized, and the practice is not increasing. The retail price of milk is 7 cents per quart throughout the year. There are no dairy herds within the city limits, but about 100 cows are kept by private families. Milk is brought to the city in wagons from 36 dairy farms, the longest haul being 7 miles.

City ordinance No. 428 and board of health ordinances Nos. 48 and 49 refer to milk. Permits for the sale of milk are issued free of charge. The sale of impure, adulterated, etc., milk is prohibited. The milk standard is 12 per cent solids, 3 per cent fat. Dairies supplying milk to the city must be kept clean, and all utensils used in handling milk must be sterilized with boiling water once a day. Garbage, etc., must not be carried in milk wagons. Condensed milk and buttermilk must be from pure milk. Condensed milk must have milk solids equivalent to 12 per cent milk solids in crude milk; 26.5 per cent of the milk solids must be fat.

About $1,300 is expended annually in the supervision of the city milk supply, one inspector giving his entire time to this work. During the past year 1,200 samples of milk were examined by the Babcock test, and all the dairy farms were inspected.

San José. (Population, 21,500.)

[For comparison with other cities in Class IV, see p. 40.]

Robert Caldwell, M. D., secretary and health officer.

The daily consumption of milk is estimated as 2,512 gallons, or 0.93 pint per capita, besides small amounts of skimmed milk and cream. Milk is sold from 40 stores and 100 wagons. Glass bottles, filled at the farms, are in general use in the delivery of milk. The retail price is 5 cents per quart throughout the year, producers receiving 3 cents in the summer and 3½ cents in the winter season. There are a few dairies near the city conducted on a more modern plan than others, but they receive no advance in price for their product. Within the city limits there are 3 herds, including 40 cows, and milk is brought in wagons from 127 dairy farms, all within 7 miles of the city.

Ordinances Nos. 1650 and 1654 refer to milk. License for the sale of milk is free. Adulterated, impure, etc., milk is prohibited. The milk standard is 13 per cent solids, one-fourth of which shall be butter fat. Skimmed milk must be labeled. Wagons must bear license number. The board of health has passed a regulation requiring that all cows furnishing milk for the city be tested with tuberculin.

Six hundred dollars is expended annually in the supervision of the milk supply, the milk and market inspector giving a part of his time to this work. During the past year milk samples were examined by the Babcock test. No bacteriological examinations were made. All the city herds and all the dairy farms were inspected.

Recent improvement in the milk supply is due to greater cleanliness at the dairies and a veterinary inspection of cows. It is stated that there would be further improvement if a State board of veterinary inspectors should examine all cows and kill those found to be affected with tuberculosis.

Alameda. (Population, 16,464.)

[For comparison with other cities in Class IV, see p. 40.]

T. Carpenter, V. S., veterinary and food inspector.

The daily consumption of milk is estimated as 1,760 gallons, or 0.86 pint per capita, besides 50 gallons of skimmed milk and 100 gallons of cream. Milk is sold from 21 stores and 38 wagons, and about 30 per cent of it is delivered in glass bottles, which are filled in the city. Several consumers pasteurize their own supply. The retail price of milk is 6¾ cents per quart throughout the year, producers receiving 3 cents in summer and 3½ cents in winter. The milk from 5 "model dairies" near the city is sold for 7½ cents per quart in summer and 8⅓ cents in winter. There are 11 herds, including 62 cows, within the city limits, and milk is sent in from 23 dairy farms. About 9 per cent is received by railway, the longest shipment being 45 miles.

Ordinances No. 318, June, 1896, and No. 368, October, 1898, and board of health regulations govern the milk supply. Permit is required for the sale of milk or cream. Impure or adulterated milk, or milk from cows within fifteen days before or ten days after calving, is prohibited. The milk standard is 12.5 per cent solids. Skimmed milk must contain 7.5 per cent milk solids and be plainly labeled. Cows must be free from dangerous disease and must not be fed upon wet brewers' grains, swill, etc., nor kept in an insanitary condition. Contagious disease among employees must be reported. Wagons must bear owner's name, etc.

Board of health rules and regulations for the handling of milk include a number of those published in the Seventeenth Annual Report of the Bureau of Animal Industry, pages 165–171. They are published on large cloth-backed cards, suitable for posting in stables, etc.

Twelve hundred dollars is expended annually in the supervision of the milk supply, one official giving his entire time to this work. During the past year 925 samples of milk were examined by lactometer, Babcock test, and gravimetric analysis; 20 bacteriological examinations were made "for milk ferments, blood corpuscles, etc.;" all the city herds and all the dairy farms were inspected.

Recently there has been an improvement in the health of the cows and in the sanitary method of handling milk. Needed improvements, as given, include the stamping out of tuberculosis and regulations to control dairy herds and the transportation of milk.

COLORADO.

This State has no milk law.

Denver. (Population, 133,859.[1])

[For comparison with other cities in Class I, see p. 26.]

Charles K. Cook, milk inspector.

S. B. Newland, deputy State dairy commissioner.

The daily consumption of milk is estimated as 12,110 gallons, or 0.65 pint per capita. It is also estimated that the city consumes daily about 1,000 gallons of skimmed milk and 2,000 gallons of cream. Milk is sold from only 200 stores, the greater part of it being distributed from 300 wagons, many delivering twice a day. About 25

[1] Including average transient population, 150,000.

per cent is delivered in glass jars, which are filled in the city or on the dairy farms. The entire product of one establishment, amounting to 4 per cent of the total milk supply, is pasteurized. The retail price of milk is 5 to 6¼ cents per quart in summer and 6¼ to 8⅓ cents in winter, the producers receiving 2½ to 3 cents per quart throughout the year. Within the city limits there are 80 herds of 3 or more cows each, including 900 head, and about 1,500 separate or private cows. About 300 dairy farms send milk into the city. Of the total supply, about 10 per cent is received by rail, the longest shipment being 150 miles.

Numerous milk regulations were published in the manual of the bureau of health in 1899. They are generally drawn up in considerable detail for the protection of milk consumers against the use of impure or adulterated milk, or milk produced in insanitary places or from cows suffering from tuberculosis or other disease. The sale of milk from cows two weeks before or two weeks after calving is prohibited. The milk standard is 12 per cent total solids, 3 per cent fat; the cream standard, 25 per cent total solids, two-thirds of which shall be butter fat. Skimmed or watered milk may be sold to any person for his own individual consumption, if he is informed of the character of the article. When milk below the legal standard is used in hotels, restaurants, etc., a sign must be displayed bearing the words "watered milk." License (fee $1 for one year) is required for each store or vehicle selling milk. A set of 10 rules relating to the production of milk—cleanliness and ventilation of stables, cleanliness of employees, straining of milk twice, cooling of milk and use of ice during its delivery in warm weather, use of screens to exclude flies from milk rooms, prohibition of preservatives—are printed on cloth by the health commissioner to be posted in dairy stables.

Ordinance section regarding notice of use of watered milk is given in Appendix I (p. 180).

The city expends annually $1,200 for the supervision of the milk supply. One milk and dairy inspector devotes his entire time to this work, and he is occasionally assisted by the city chemist. During May, June, July, and August 1,200 samples of milk and 1,000 samples of cream were examined by the Babcock test, 600 samples were analyzed gravimetrically, and a few samples of milk were examined bacteriologically. All of the milch cows within the city limits and all the dairy herds outside which send milk to the city have been inspected.

Pueblo. (Population, 28,157.)

[For comparison with other cities in Class III, see p. 34.]

H. R. Thompson, milk and dairy inspector.

The daily consumption of milk is estimated as 5,000 gallons, or 1.42 pints per capita; also 350 gallons of skimmed milk and 200 gallons of cream. Milk is sold from 10 stores and 40 wagons. Thirty-three per cent of the milk is delivered in glass bottles, which are filled at the farms; none is pasteurized. The retail price of milk is 6 cents per quart in summer and 7 cents in winter. Within the city limits there are 20 herds, including 650 cows, and milk is sent in from 17 (?) dairy farms. Ten per cent of the cream is received by railway, the longest shipment being 20 miles.

The city expends annually about $1,000 in the supervision of its milk supply, one dairy and milk inspector giving his entire time to this work. In the past nine months 344 samples of milk were examined by the lactometer, Babcock test, and by chemical tests for preservatives; no bacteriological examinations were made; all the city herds and all the country farms were inspected, 15 of the city herds being tested with tuberculin.

Recently there have been a higher fat content and a marked decrease in the use of preservatives. Needed improvements, as given, include better methods for cooling and aerating milk, sterilizing cans, and better sanitary conditions at the dairies.

Colorado Springs. (Population, 21,085.)

[For comparison with other cities in Class IV, see p. 40.]

R. H. Custer, food inspector.

The daily consumption of milk is estimated as 1,800 gallons, or 0.68 pint per capita, besides 300 gallons of skimmed milk and 80 gallons of cream. This does not include the milk from about 200 cows kept by private families. Milk is sold from 19 stores and 28 wagons. None of the milk is shipped in glass bottles, but nearly all dairies use them and charge a higher price for the bottled product. Pasteurized milk is used by invalids, and at present many private families do their own pasteurizing. The retail price of milk is 5 cents per quart throughout the year, bottled milk 6¼ cents, and pasteurized milk 8½ cents, producers receiving 3 cents to 3½ cents per quart. The milk from 3 "model dairies" is sold for 6¼ cents. Within the city there is 1 herd (60 cows), and milk is sent in from 17 dairy farms. The longest shipment of milk to the city is 14 miles.

An ordinance adopted in December, 1897, refers to milk. License fees for the sale of milk or cream are $5 for each wagon and store; $5 for each shipper who does not send to a licensed dealer; but persons who keep not more than 2 cows, and stores which sell milk or cream from a regular registered dairyman, pay only $1. Impure, adulterated, etc., milk is prohibited, except that skimmed or watered milk may be sold if the buyer is informed of its character. "Watered milk" sign must be displayed in restaurants, etc., where milk is served that contains less than 3 per cent fat. The milk standard is 12 per cent solids, 3 per cent fat. Cream standard is 25 per cent solids, 16 per cent fat. Those handling milk must not be suffering from or exposed to contagious disease.

The food inspector (salary $1,020) gives a part of his time to the supervision of the milk supply. During the past year 175 samples of cream were analyzed gravimetrically; 3 samples were examined bacteriologically for typhus and tubercle bacilli; and 8 (of the 18) dairy herds were inspected.

Trinidad. (Population, 5,345.)

[For comparison with other cities in Class IV, see p. 40.]

D. F. Dayton, health officer.

The daily consumption of milk is estimated as 500 gallons, or 0.75 pint per capita. Milk is sold from 10 wagons, but no stores, and about two-thirds of it is delivered in glass bottles, which are filled at the farms. Dairies do not supply pasteurized milk. The retail price of milk is 6¾ cents per quart throughout the year. There are no "model dairies" near the city, and no herds within the city limits. Milk is supplied from dairy farms within a radius of 3 miles.

The milk standard, as given by the health officer, is 12 per cent solids, one-fourth of which shall be butter fat. The cream standard is 25 per cent solids, two-thirds of which shall be butter fat.

No specific amount is appropriated for the supervision of the milk supply. During the past year 8 samples of milk were examined by lactometer, Babcock test, and gravimetric analysis; no bacteriological examinations were made; all the dairy farms were inspected. The inspector states that the milk supply would be improved if dairymen were more particular about keeping the cows' udders clean, and cooling the milk immediately after milking.

CONNECTICUT.

J. B. Noble, dairy commissioner, Hartford.

General Statutes, revision of 1887, sections 2660–2664, and Public Acts of 1899, chapter 209 refer to milk, etc. The warden and burgesses of any borough, or the mayor and common council of any city, may appoint a milk inspector, who may

supervise the milk supply, and is authorized to take samples (but in duplicate when requested); persons selling milk may be required to register with the city or borough clerk, the latter receiving 15 cents from the public treasury for each name registered. It is unlawful to sell impure or adulterated milk, or knowingly to sell milk from a cow that has been "adjudged, by the commissioners upon diseases of domestic animals, affected with tuberculosis or other blood disease." Skimmed milk shall be labeled as such when sold.

Public Acts of 1895, chapter 235, sections 4 and 5, refer to food products, and forbid the sale of articles that are adulterated or misbranded, these terms being defined at length. The State agricultural experiment station may fix standards of purity. The State dairy commissioner conducts prosecutions.

The State exercises very little supervision over market milk. The commissioner has examined numerous samples in connection with the experiment station.

New Haven. (Population, 108,027.)

[For comparison with other cities in Class I, see p. 26.]

Ward Bailey, clerk of the city board of health.

The average amount of milk consumed daily is 8,750 gallons, or 0.65 pint per capita. The amounts of skimmed milk and cream are not recorded. Milk is distributed from about 400 stores and 200 wagons. Glass bottles are used in the delivery of a large part of the milk supply, most of them being filled in the country. A little of the milk is pasteurized, and the quantity so treated does not seem to be increasing. The retail price of milk is 6 cents per quart in summer and 7 cents in winter, producers realizing 3½ cents and 4 cents in the two seasons. About half a dozen dairies near the city are conducted considerably better than others, but do not receive an extra price for their milk. There are no herds and only a few milch cows within the city limits. The average distance from which the milk supply is received is 10 miles.

The milk ordinance requires that venders of milk shall be licensed by the board of health. License fee is 50 cents, and licenses expire the 1st of each May. They are revocable for cause. The license number must be shown on wagons. The sale of adulterated, etc., milk, which is defined at length, is prohibited. The milk standard is 11.5 per cent total solids, 3.5 per cent fat, and specific gravity between 1.029 and 1.033. Skimmed milk may be sold if in vessels plainly labeled.

No special appropriation is provided for the supervision of the milk supply, and the entire time of no officer is given to this work. During the past year 74 samples of milk were examined with the lactometer and the Babcock test, 25 being found below the standard for butter fat, and 12 dairy farms were inspected.

There is less adulteration of milk now than formerly. There is need of a milk inspector, frequent inspection of dairy farms, and more cleanly methods where milk is produced and handled.

Hartford. (Population, 79,850.)

[For comparison with other cities in Class II, see p. 30.]

Edmund D. Roberts, milk inspector.

The daily consumption of milk is estimated as 9,000 gallons, or an average of 0.90 pint per capita, besides 600 gallons of skimmed milk, and 115 gallons of cream. It is explained that many nonresidents take their meals in the city, thus partly accounting for the apparently large average consumption. Milk is sold from 53 stores and 195 wagons. Glass bottles are used in the delivery of about one-fourth of the total milk supply, the greater part of them being filled at the farms. The experience of three dairymen who have abandoned the practice of pasteurizing is proof that there is little or no demand for pasteurized milk in the city. The retail

price of milk is 6 to 7 cents per quart in summer and 7 to 8 cents in winter, the producers receiving 2½ to 3 cents per quart in summer and 3½ to 4 cents in winter. There are numerous well-conducted daries in this locality, some of which receive as high as 10 cents per quart throughout the year. Within the city limits there are 20 herds of milch cows, including 300 head, and milk is sent into the city from 171 dairy farms averaging about 22 cows each. About 3 per cent of the supply is shipped in by railway, the longest shipment being 20 miles.

Ordinance of Hartford, 1897, chapter 11, sections 15 to 23, refers to milk. Persons selling milk must be licensed; fee, 25 cents. The sale of adulterated or impure milk is prohibited. The milk inspector has made a standard for milk of 12.3 per cent solids, 3.5 per cent fat.

About $500 is expended annually in the supervision of the city milk supply, one officer giving the greater part of his time to this work. During the past year 651 samples of milk were examined by lactometer and the Babcock test; all of the city herds and 35 of the 171 dairy farms were inspected; inspections of places in private residences where milk is kept were made during the spring, summer, and fall months.

Recent improvements are shown in the care of cows and cleanliness in handling the milk. The inspector believes that stringent milk laws may do more harm than good.

Bridgeport. (Population, 70,996.)

[For comparison with other cities in Class II, see p. 30.]

E. A. McLellan, M. D., health officer.

The daily consumption of milk is estimated as 6,250 gallons, or 0.70 pint per capita, besides 250 gallons of cream. No skimmed milk is sold. Milk is sold from 200 stores and 250 wagons. In the delivery of milk, 7 establishments use glass bottles, these being filled in the city. No milk is pasteurized. The retail price of milk is 7 cents per quart in the summer and 8 cents in the winter season, producers receiving 3 cents per quart in summer and 4 cents in winter. There are no "model dairies" near the city. There are 8 herds of milch cows in the city. About one-twelfth of the total milk supply is received by railway, the longest shipment being 75 miles.

The city expends nothing in the supervision of its milk supply. Samples of milk are occasionally sent to the State experiment station for analysis. No dairy cattle have been inspected.

Needed improvements, as given, include the inspection of dairy herds, greater cleanliness in handling milk, and proper cooling facilities during the hot season.

Waterbury. (Population, 45,859.)

[For comparison with other cities in Class III, see p. 34.]

P. T. Keeley, M. D., milk inspector.

The average daily consumption of milk is estimated as 5,000 gallons, or 0.87 pint per capita; also 250 gallons of skimmed milk and 250 gallons of cream. Milk is sold from 130 stores and 125 wagons. Glass bottles, filled in the city, are used in the delivery of 25 per cent of the milk supply. Very little milk is pasteurized, and the practice is not increasing. The retail price of milk is 5 cents per quart in summer and 7 cents in winter, the producers receiving 3 cents in summer and 4½ cents in winter. No dairies are conspicuous for being conducted in a better manner than others. Within the "town" there are 200 herds, including 3,000 milch cows. Two hundred and fifty dairy farms send milk into the city. About 5 per cent is received by railway, the longest shipment being 20 miles.

The city expends annually about $1,000 in the supervision of its milk supply, one official giving his entire time to this work. During the past year 1,000 samples were

examined by Babcock test, lactometer, and gravimetric analysis; two bacteriological examinations were made for typhus bacilli; all herds supplying the city with milk were inspected four times.

Improvement has recently been shown in the sanitary condition of dairies. Further improvement would result if milk samples and sanitary conditions of dairies were studied by a trained bacteriologist.

New Britain. (Population, 25,998.)

[For comparison with other cities in Class III, see p. 34.]

A. L. Thompson, city clerk.

The daily consumption of milk is estimated as 1,500 gallons, or 0.46 pint per capita, besides 50 gallons of skimmed milk and 10 gallons of cream. Milk is sold from about 30 wagons and no stores. Nearly all the dealers deliver milk in glass bottles, which are filled at the farms. Considerable milk is pasteurized, and this practice is increasing. The retail price of milk is 6 to 7 cents in summer and 7 to 8 cents in winter, producers receiving 5 and 6 cents per quart in the two seasons. There are no dairies near the city which are conducted in an entirely satisfactory manner. One herd of 40 cows within the city limits and 28 herds outside produce the milk supply.

Nothing is done to supervise the milk supply.

DELAWARE.

This State has no milk law.

Wilmington. (Population, 76,508.)

[For comparison with other cities in Class II, see p. 30.]

Walter A. McEvilly, inspector of milk.

The daily consumption of milk is estimated as 3,756 gallons, or 0.39 pint per capita, besides 250 gallons of skimmed milk and 25 gallons of cream. Milk is sold from 55 stores and 341 wagons. About one-half of the milk supply is delivered in glass bottles, some of these being filled in the city and some at the producing farms. No milk is pasteurized. The retail price of milk is 6 cents per quart in summer and 8 cents in winter, producers receiving 3 and 4 cents in the two seasons. There are no so-called model dairies in the vicinity. Within the city limits there are 9 herds, including 85 cows. Two hundred dairy farms send milk into the city. About one-half of the total supply is received by railway, the longest shipment being 40 miles.

An ordinance adopted in December, 1901, amending a previous ordinance, refers to milk. Adulterated, etc., milk is prohibited. Skimmed milk must be labeled. The milk standard is 12 per cent total solids, 3 per cent fat.

The city expends annually $1,500 in the supervision of its milk supply. Two officials—a chemist and an inspector—give their time to this work. The milk inspector receives $1,000 salary and finds his own implements. During the past year 125 samples of milk were examined by lactometer; all samples not up to standard were analyzed gravimetrically; 125 samples were examined bacteriologically; all the dairy farms sending milk into the city were inspected, but none of the dairy herds within the city were inspected.

Suggested improvements include the rigid enforcement of milk laws and the maintenance of prices which will enable dealers to sell the pure article.

livery of milk. They are not used for shipping, but are filled in the city. 100 gallons of pasteurized milk is sold daily; this treatment does not seem ning in favor. The retail price is 6 to 8 cents per quart throughout the year, ucers on the farms receiving 2 to 3 cents in summer and 3½ to 4½ cents in One or two dairies near the city are conducted in an entirely satisfactory and their milk is retailed at 10 to 12 cents per quart. One hundred and dairy herds, including 1,127 cows, are within the limits of the District bia, and milk is sent into the District from 630 dairy farms, the longest being 92 miles.

r 164, Session III, Fifty-third Congress, March, 1895, refers to the milk the District of Columbia. A permit from the health officer is required for ing a dairy within the District. This is issued after the dairy premises have pected and approved. Permit is also required for sending milk into the his to be issued if the health officer is satisfied with the detailed description iry farm, and the sworn statement as to the physical condition of the cattle, ust accompany the application. Every person receiving this permit must llow his premises to be inspected at any time, and to conform to the health egulations. Permits are issued without charge and are revocable for cause. n is debarred from selling milk during the time his application for permit onsidered. Persons recently exposed to contagious disease shall not work . Milk wagons must show permit number, location of dairy, etc. Names nen furnishing milk must be displayed in stores, etc., where milk is sold. of unwholesome or adulterated milk, or milk from cows fed on swill, etc., rom diseased cows, or milk taken from cows less than 15 days before or 10 r parturition is prohibited. Skimmed milk may be sold if plainly labeled; rd is 9.3 per cent solids.

r 25, Session II, Fifty-fifth Congress, refers to foods. It prohibits adulter- , the same being defined at length and including milk altered in any way, kes the milk standard 9 per cent solids not fat, 3.5 per cent fat, and the ndard 20 per cent fat.

authority of the first law above mentioned, regulations governing the milk e made by the health officer. They specify, in considerable detail, condi- ch shall be found where milk is produced and handled, requiring sanitary

Recent improvements are shown in the sanitary conditions of dairy farms and the health of the herds. Recommendations for further improvement include: An official indorsement of properly conducted dairies; the eradication of tuberculosis from dairy herds; better lighting, ventilation, and drainage, and greater cleanliness of barns and dairies; the branding of condemned cows; the immediate cooling of milk and its maintenance at a low temperature till final delivery.

In a special report, dated May 3, 1900, by Dr. J. P. Turner, inspector of live stock and dairy farms, prepared, under the direction of the health officer, in compliance with a resolution of the Senate, much interesting information is given regarding the conditions existing on dairy farms supplying milk and cream to the District and the amount of work performed in the interest of their improvement. It states that there were in the District 135 farms producing daily 2,000 gallons of milk, some of these farms being inspected as often as once a month. Only about one-third of the 600 dairy farms in Virginia and Maryland sending milk into the District had been inspected. Wherever inspections are made, the following points are included: The physical examination of cows, the sanitary condition of the barn, methods of cleaning and milking the cows, facilities in the dairy room for cooling and handling milk, and the character of the food and water supply. About 3,500 gallons of milk from uninspected dairy farms were received daily over the Baltimore and Ohio Railroad, and the same amount over the Southern Railroad. Permits are held by all the shippers of this milk, having been given on a basis of their own statements of conditions in their dairies. It is well known that the sanitary conditions on many farms are not such as the health department regulations require, as, whenever the area in which inspections are made is extended, many diseased cows are found and many buildings have to be abandoned or altered. In the inspected area, which supplies about one-third of the milk used in the city, 140 diseased cows were condemned in 1897 and 120 in 1899. It is shown that not a few of the veterinarian's reports upon herds beyond the inspected districts are unreliable. Tuberculosis is the disease most commonly found, over 50 per cent of the cows condemned being affected with it. The tuberculin test has been the means of finding many badly diseased animals which could not be detected by a thorough physical examination. The importance of requiring the removal of diseased cows from dairy farms, after their condemnation, is emphasized. It is recommended also that farmers be reimbursed for at least a part of their loss when their cows are condemned. Many dairy barns have been greatly improved by the construction of good floors and gutters, windows, and ventilators, and the use of whitewash has done much to improve their sanitary condition. The old dark basement barn is gradually disappearing. In some respects, methods of milking are more cleanly than in the past, though there is yet much room for improvement. Cows are kept fairly clean, but the filthy habit of "wet" milking and the neglect of personal cleanliness prevails in too many dairies. The use of separate milk rooms and the cooling of milk to below 50° F. is strongly recommended. The feeds given milch cows are generally satisfactory. Some farmers are using ensilage and no unfavorable results have been noted when the silo was properly built and filled. In making inspections, special attention is given to the water supply.

The report above abstracted was accompanied by one from the chemist and inspector of dairy products. The only forms of intentional adulteration of milk are the addition of water, coloring matter, and preservatives, and the removal of cream. A few years ago these were very common, but to-day they exist only to a small extent. Unintentional forms of adulteration, through which different forms of bacteria, including the germs of disease that are most likely to enter the milk, are discussed at length. The amount of acidity found in 146 samples of milk, collected in one year, varied between wide limits; 5 samples contained from 1.08 to 3.25, the remaining 141 varied from 0.27 to 0.96 per cent acidity, their average being 0.52 per cent.

During a recent winter a bacteriological study of the milk sold in the District was made by the veterinary inspector, the bacterial content per cubic centimeter was found to vary from 2,500 to 100,000,000. Of 117 samples examined, 9 contained more than 1,000,000 bacteria per cubic centimeter, 36 contained from 100,000 to 1,000,000, and 20 contained less than 10,000 per cubic centimeter.

FLORIDA.

Revised Statutes, sections 2659 and 2660, refer to foods. It is unlawful to sell diseased or unwholesome food except when the buyer is fully informed, and the sale of food adulterated with any substance injurious to health is forbidden.

Jacksonville. (Population, 28,429.)

[For comparison with other cities in Class III, see p. 34.]

Claude Joyner, health officer.

The daily consumption of milk is estimated at 1,200 gallons, or 0.34 pint per capita. Milk is sold from 75 stores and 35 wagons. About one-half of the milk is supplied in glass bottles, and these are filled at the farms. A large amount of milk is pasteurized, but the practice is not increasing. Milk is retailed at 10 cents per quart throughout the year, the producers receiving 7 cents per quart. There are no "model dairies" near the city. There are no dairy herds within the city limits. The milk supply is produced by 560 cows on 35 dairy farms, within 4 miles of the city.

An ordinance adopted in April, 1888, and amended in October, 1899, refers to milk. The health officer must examine the city milk supply. License is required for the sale of milk. Adulterated, etc., milk is prohibited. The water at dairies must be pure. The milk standard is 12 per cent solids, 3 per cent fat, board of health lactometer reading of 100° at 60° F., and show "6 per cent of cream by the lactometer."

During the past year 185 samples of milk were examined by lactometer and Babcock test, and all the dairy farms were inspected.

GEORGIA.

Acts of 1895, part 1, title 7, No. 207, sections 1 and 2, refer to milk. The sale of unclean, unwholesome, or adulterated milk, or milk from an animal less than 15 days before or 5 days after parturition is prohibited. The milk standard is 3.5 per cent fat, 8.5 per cent other solids. Skimmed milk and buttermilk may be sold as such.

Atlanta. (Population, 89,872.)

[For comparison with other cities in Class II, see p. 30.]

George M. Hope, chief of the sanitary department.

Estimated amount of milk used daily is 1,500 gallons, or 0.13 pint per capita; also 300 gallons of skimmed milk, 101 gallons of cream, and 2,500 gallons of buttermilk. Milk is distributed from 10 stores and 350 wagons. Glass jars are used to a certain extent, being filled in the country or in the delivery wagons in the city. None of the milk is pasteurized. The retail price per quart for milk is 5 cents in summer and 6 cents in winter, producers receiving 3 cents in summer and 4 cents in winter. The few "model dairies" sell their product at 7 cents per quart in summer and 9 cents in winter. About 2,129 milch cows in 3 city herds and 350 country herds furnish the city with milk. Only about 300 gallons of milk are received by railway, the longest shipment being 20 miles.

Two inspectors devote a large part of their time to the supervision of the city milk supply, having examined during the past year 1,250 samples chemically, but none bacteriologically; and inspected all of the city dairies and nearly all of the farms sending milk into the city. A report issued by the city board of health in 1899 shows that about 8 per cent of the samples analyzed failed to come up to the requirements of the law, while 62 per cent showed more than 13 per cent total solids.

It is claimed that the milk standard should be raised.

Savannah. (Population, 54,244.)

[For comparison with other cities in Class II, see p. 30.]

W. F. Bunner, health officer.

The daily consumption of milk is estimated as 3,000 gallons, or 0.44 pint per capita, besides an unknown quantity of skimmed milk and cream. Milk is sold from 10 stores and numerous wagons. Glass bottles are used in the delivery of milk by all the best dairy establishments. Those outside the city fill the bottles at the producing farms. No milk is pasteurized. Milk retails for about 10 cents per quart throughout the year. Three dairies near the city are conducted in a very satisfactory manner, their milk selling at the regular rate. The number of herds of milch cows within the city is not known, but about 15 dairy farms send milk into the city. Practically all the milk used is produced within a radius of 5 miles.

The city has no ordinance regulating the milk supply and no work has been done along this line.

Recent improvements are due to the introduction of high-grade cattle, better water supply at dairies, and more care in the conduct of the dairy business. Milk ordinances are very much needed.

Augusta. (Population, 39,441.)

[For comparison with other cities in Class III, see p. 34.]

Thomas D. Coleman, M. D., secretary of the board of health.

The average amount of milk sold daily is estimated as 600 gallons, or 0.12 pint per capita. In explanation of this apparently low per capita consumption of milk, it is stated that many families keep 1 or 2 cows, and that the milk from these is not included in the above estimate. Milk is sold from 1 store and 30 wagons. Nearly all the dairymen use glass bottles in the delivery of milk, and these are filled at the farms. No milk is pasteurized. The retail price of milk is 4 to 6¼ cents in summer, and 6¼ to 7½ cents in winter. There are no "model dairies" near the city. Dairy herds are not allowed in the city. Milk is sent in from about 20 dairy farms, the most distant being 6 miles from the city.

The city conducts no inspection of the milk or herds.

HAWAII.

Laws of 1898, act No. 34, refers to foods. It forbids the sale of any adulterated food, which term is defined at length and so as to include impure milk.

Honolulu. (Population, 39,306.)

[For comparison with other cities in Class III, see p. 34.]

Edmund C. Shorey, food commissioner for Hawaiian Territory.

About 1,000 gallons of milk is sold daily by milkmen, or 0.20 pint per capita, besides 12 gallons of cream. No skimmed milk is sold as such. In explanation of the small amount of milk reported, it is stated that some private families keep cows and sell milk to their neighbors, and that canned condensed milk instead of natural milk is used largely by native Hawaiians, Asiatics, and others. Milk is sold from

30 wagons, and cream is sold from 3 stores. Glass bottles are used in the delivery of most cream sold, but not for milk. No milk is pasteurized, but a small quantity of cream is thus treated, and the practice is increasing. Some sterilized cream comes from California. The retail price of milk is 10 to 15 cents per quart throughout the year, and of cream 50 to 60 cents per pint. Producers of milk in all cases retail their own product. No dairy near the city is conducted in an entirely satisfactory manner. Thirty-seven herds, including about 900 cows, and located within 6 miles from the center of the city, furnish the milk supply; one herd more distant supplies milk and cream to steamships.

No milk standard has been fixed by law, but the minimum obtained by numerous analyses is used for comparison in prosecutions. License fee for selling milk is $2.50.

In the supervision of its milk supply the city expended last year $1,660—$700 to the food commissioner, or one-third of his salary, $900 to the milk inspector, and $60 for laboratory expenses. The milk inspector gives his entire time to this work. During the past year 700 samples of milk were examined for composition by the lactometer and Babcock test, and in suspicious cases by gravimetric analyses (very few samples were examined in January and February on account of an epidemic of plague); no samples were examined bacteriologically; 10 herds were tested with tuberculin. Milk has been found to contain as high as 40 per cent of added water. In the year there were 11 prosecutions for the sale of adulterated milk, resulting in 9 convictions with fines from $25 to $100. The milk inspector's analyses of herd milk known to be pure showed an average of 12 per cent solids, 3.5 per cent butter fat, minimum solids 11 per cent, and minimum fat 2.5 per cent. Dairy work is often conducted in a very crude manner; many of the employees are Japanese or Portuguese, and ignorant of modern methods. It is a common practice to allow the calves being raised to suckle the cows. The calf is usually allowed to take the last of the milk, which is the richest in fat. A number of analyses of herd milk, showing the results of allowing the calves to take the first or last portion of the milk in the udder, or none at all, are as follows:

Part of milk taken by calves.	Total solids.	Butter fat.
When the calves took the first part of the milk	13.2	4.6
When the calves were allowed to have none	12.8	4.0
When a few calves took the last part of the milk	12.5	3.6
When a large number took the last part of the milk	11.5	2.8

Recent improvement in the milk supply is due to less adulteration with water and better care of milk utensils, the latter resulting in less sour and ropy milk. It is stated that a milk standard should be fixed, and information regarding the care of cows and milk should be distributed to dairymen.

IDAHO.

Revised Statutes of 1897—section 6918 refers to foods. The adulteration of any article of food or drink with fraudulent intent, or sale of same as unadulterated, is a misdemeanor.

ILLINOIS.

Alfred H. Jones, State food commissioner, Chicago.

Laws of 1879, page 111, and 1897, page 268, refer to milk. Cows producing market milk must not be kept in an unhealthy condition, nor shall any person (knowingly) give them unwholesome food, which includes "distillery waste, usually called 'swill,'" and other substances in a state of putrefaction. It is unlawful to sell milk or cream adulterated by the addition of water or any foreign substance. The milk

standard is 12 per cent solids, 3 per cent fat. Skimmed milk shall be sold as such in any city and only from cans plainly labeled. Persons retailing milk in cities shall have plainly marked on each can and vehicle the name of the owner and the name of the locality where the milk is produced. Condensed milk shall be made from milk containing at least 3 per cent of butter fat and evaporated to one-third or less of original volume; the word "cream" on cans is evidence of fraud; condensed skimmed milk must be labeled. The addition of sugar to condensed milk is permitted. Canned goods must be labeled to show grade and name of manufacturer.

Laws of 1899, page 368, refer to the State food commissioner. It is his duty to enforce all dairy laws, to inspect foods believed to be unhealthful or adulterated, and to prosecute for their sale. State's attorneys assist in prosecutions. This law forbids the sale of foods that are adulterated, which term is defined at length, and under its authority the commissioner has announced the following standards: Milk, 3 per cent fat; "coffee cream," 15 per cent fat; "whipping cream," 22 per cent fat.

Chicago. (Population, 1,698,575.)

[For comparison with other cities in Class I, see p. 26.]

Thomas F. Grady, superintendent of milk inspection, board of health.

Adolph Gehrmann, M. D., director of laboratory, board of health.

It is estimated that 169,465 gallons of milk are used daily. This is equivalent to a supply of 0.8 pint per capita, but it is probable that this does not represent the average per capita consumption because a considerable quantity of the milk is used in the manufacture of oleomargarine, and much is consumed daily in the city by persons not included in its stated population. The amounts of skimmed milk and cream are not known. There are 4,629 firms engaged in selling milk; 2,162 of these sell from licensed stores, 1,867 sell from 2,692 licensed wagons; and 600 parties sell milk from their own cows. About one-third of the milk peddlers use glass bottles for a part of their trade and only 49 of these sterilize the bottles. Over 115,000 quarts of bottled milk come into the city each day, half of it being supplied by a single firm. Only two concerns fill all of their bottles in the country. Pasteurized milk is used but little, and it is not gaining in favor. The retail price per quart of milk is 5 to 7 cents in the summer and 6 to 7 cents in the winter season, the producers on the farms being paid in the two seasons $2\frac{1}{2}$ cents and $3\frac{1}{2}$ cents, respectively.[a] The milk from

[a] The Milk News is responsible for the following table, which shows a considerable increase in the price paid to milk shippers. The figures were compiled from shippers' books and office records and represent the price prevailing the longest time in each month. Prices given are for 8-gallon cans delivered on the Chicago platform, freight prepaid:

Month.	1894-95.	1895-96.	1896-97.	1897-98.	1898-99.	1899-1900.
May	$0.55	$0.60	$0.65	$0.65	$0.65	$0.75
June	.55	.60	.65	.65	.65	.75
July	.60	.65	.75	.70	.75	.85
August	.65	.65	.75	.75	.85	.85
September	.70	.70	.75	.80	.90	.95
October	.85	.70	.80	.85	.90	.95
November	.90	.85	.85	1.00	1.15	1.15
December	.90	.87	.80	1.00	1.10	1.15
January	.80	.90	.80	1.00	1.00	1.10
February	.80	.90	.75	.80	1.00	1.10
March	.75	.75	.70	.80	.90	.95
April	.70	.70	.70	.80	.90	.90

two dairies near Chicago, which are conducted in an entirely satisfactory manner, is sold throughout the year for from 7 to 12 cents per quart. Within the city limits there are 30 dairy herds, including 420 cows, besides 1,830 cows kept privately, 1, 2, or 3, in a place. The amount of milk produced by the city cows is 4,500 gallons daily. Milk is sent into the city from 4,000 dairy farms, and about 97 per cent of their product is shipped in over 16 railroads, the longest shipment being 123 miles. The charge for hauling an 8-gallon can of milk varies from 8 to about 22 cents.

Sections 933–965 of the municipal code relate to the city milk supply. Among their provisions are the following: A milk and food division is created in the department of health, the chief officer being known as the superintendent. He and his first assistant must each give bond for $5,000, and each inspector must give bond for $2,000. The officers are supplied with badges and are given necessary authority for making inspections. No inspector is allowed to serve in one district longer than four consecutive weeks, at the end of which time he can not again serve there until he has served in at least two other districts. Licenses, to be renewed the first of each May, must be obtained by milk or cream sellers (excepting persons owning 1 or 2 cows, and hotels, restaurants, etc., where milk or cream is furnished with meals); the fee is $10 for each store and each wagon. Licenses will be granted for a portion of the year at a proportionate rate. They must be displayed in stores, and delivery wagons must bear metal signs obtained from the city clerk showing that they have been licensed. The milk standard is 12 per cent total solids, 3 per cent butter fat; cream standard 15 per cent butter fat; skimmed milk may be sold if plainly labeled by means of a metallic tag; buttermilk is allowed if pure. Condensed milk must be made from pure milk and be in packages plainly labeled to show by whom condensed. The ordinance prohibits the sale of milk or cream for human food which is unclean, impure, adulterated by the addition of water or any foreign substance; milk or cream from diseased cows, cows within fifteen days before and twelve days after parturition, cows kept in an unhealthy condition or fed distillery or brewery refuse or other fermented food; milk or cream exposed to infection from diseased persons or animals. Impure milk and cream, including the product of diseased cows or cows fed on refuse, etc., shall be confiscated when found. Cow stables (in the city?) shall be washed out and thoroughly cleaned each week. Milk vessels, refrigerators, and all places where milk is stored must be kept scrupulously clean.

The ordinance sections regarding qualifications, requirements, and duties of milk-inspection officials are given in Appendix I (p. 177).

The ordinance section referring to signs on delivery vehicles is given in Appendix I (p. 177).

The city expends annually in the supervision of its milk supply about $10,000, and 7 officials—1 superintednent, 5 inspectors, and 1 milk tester—give their entire time to this work. During the past year 19,053 samples of milk and cream were examined by the Babcock test and lactometer and some of them by gravimetric analysis, and 126 samples were examined, upon requests of citizens, for tubercle bacilli. "Of the 19,053 samples of milk and cream analyzed 4,926 were brought to the laboratory by private individuals (the remaining 14,127 were collected by the milk inspectors). Of the 14,127 inspectors' samples 1,813 where tagged skimmed milk and 7,970 were not tagged, therefore sold for whole milk; of these, 859 were found below grade. Out of 4,344 samples of cream, 154 were found below grade. Percentage of inspectors' samples of milk and cream below grade, 7.17. Of the 4,926 samples brought to the office by private individuals, 3,107 were milk, of which 328 were below grade, and 1,813 were cream, of which 104 were below grade. Percentage of samples of milk and cream brought to office found below grade, 8.77. Percentage below grade,

all sources, 7.58.[a] The numbers of examinations made each month, with their results, are shown in the table following. The daily records of the examinations of milk are kept on forms similar to this table:

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[a] In a report of the department of health it is shown that the percentage of milk samples found below grade in the last eight years has been as follows:

	Per cent.		Per cent.
1893	45.4	1897	5.8
1894	35.7	1898	6.2
1895	27.7	1899	7.9
1896	5.2	1900	7.6

Commissioner Reynolds calls attention to the fact that in this period there has been a decided decrease in the mortality of infants.

Milk report for the year ended December 31, 1900, Chicago, Ill.

Month.	Total examinations milk and cream (all sources).	Inspector's samples.														Brought to office.										
		Total milk and cream.	Milk.						Cream.			Color.	Water.	Preservatives.	Condensed.	Total milk and cream.	Milk.			Cream.			Color.	Water.	Preservatives.	Condensed.
			Tagged.			Not tagged.																				
			Number.	Low in fat.	Up in fat.	Number.	Low in fat.	Up in fat.	Number.	Low in fat.	Up in fat.						Number.	Low in fat.	Up in fat.	Number.	Low in fat.	Up in fat.				
January	1,237	723	70	39	31	412	42	370	245	10	235	6	11	0	0	514	325	41	284	189	8	181	0	0	0	0
February	1,331	958	122	68	54	587	56	531	306	18	288	23	15	0	4	373	244	37	207	127	23	104	0	0	0	13
March	1,889	1,485	184	112	72	846	90	756	455	25	430	28	18	33	54	404	240	37	203	164	29	135	10	12	30	17
April	2,358	1,906	229	168	61	1,071	92	979	610	13	597	4	12	77	0	452	304	58	246	148	10	138	2	8	113	0
May	2,018	1,584	186	139	47	933	84	849	493	4	489	0	3	60	18	434	255	20	235	172	4	168	0	4	33	5
June	2,083	1,593	161	101	60	964	120	844	458	10	448	0	8	46	0	490	370	26	294	170	2	168	0	10	26	0
July	2,052	1,607	191	136	55	948	90	858	468	14	454	0	60	35	0	445	277	20	257	168	1	167	0	29	8	0
August	1,706	1,395	208	124	84	748	103	645	439	10	429	0	113	8	4	311	208	6	202	103	1	102	0	11	6	7
September	1,462	1,072	176	186	70	542	88	454	354	24	330	0	38	15	8	390	264	24	240	126	6	120	0	10	16	1
October	671	310	58	42	16	141	21	120	111	7	104	0	4	4	4	361	313	17	196	148	8	140	0	6	6	3
November	947	578	87	40	47	286	33	253	205	9	196	0	3	10	14	369	220	26	194	152	5	147	0	12	6	4
December	1,299	916	141	80	61	492	40	482	283	10	273	2	13	5	9	383	237	16	221	146	7	139	0	13	4	1
Total	19,053	14,127	1,813	1,155	658	7,970	859	7,111	4,344	154	4,190	63	298	293	115	4,926	3,107	328	2,779	1,813	104	1,709	12	116	248	51

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Inspection of premises in the city where milk is handled shows the following:

Condition of premises.	Stores.	Peddlers' premises.	Premises where cows are kept.
Good sanitary condition	1,100	839	194
Fair sanitary condition	1,043	929	411
Bad sanitary condition	10	90	48
Not reported upon	9	9	45
Total	2,162	1,867	698

There were during the year 618 prosecutions—99 for selling milk or cream below standard and 519 for selling without license; 357 were settled by the payment of costs, and 176 by fines of $25 or more. All of the dairy herds within the city and 11 of the 4,000 outside have been inspected during the past year.

The form for application for milk license is shown in Appendix IV (p. 188).

Recent improvement in market milk is shown by its larger average fat content than formerly and the decreasing use of preservatives. Recommendations as given include a thorough system of dairy inspection with the assistance of State authorities, the registration of dairies and certification as to their sanitary condition, the use of the tuberculin test, and frequent instead of occasional or no inspections.

Peoria. (Population, 56,100.)

[For comparison with other cities in Class II, see p. 30.]

F. C. Bourscheidt, M. D., commissioner of health.

The daily consumption of milk is estimated as 5,000 gallons, or 0.71 pint per capita, besides 500 gallons of skimmed milk and 450 gallons of cream. Milk is sold from 45 stores and 80 wagons. Glass bottles are used in the delivery of milk from 6 or 8 establishments, the greater part of these being filled at the producing farms. No milk is pasteurized. The retail price of milk is 5 to 6 cents per quart in summer and 5 to 7 cents in winter, the producers receiving 3 cents per quart in summer and 3½ cents in winter. There are no "model dairies" in or near the city. There are 23 dairy herds, including 446 head, within the city limits, and 78 dairy farms, with 1,262 cows, send milk into the city. About 260 gallons of cream is shipped into the city by railway, the longest shipment being 50 miles.

An ordinance adopted October, 1899, refers to milk. License fee for selling milk is $5. The board of health may require the examination of all cows whose milk comes to the city, the owner paying 25 cents per cow. Milk from cows that are diseased, etc., milk from a place where a contagious disease exists, or adulterated milk, is prohibited. Milk standard, 12 per cent solids, 3 per cent fat; cream standard, 25 per cent solids, two-thirds of which must be fat. Skimmed milk must be labeled.

Fifteen hundred dollars is expended annually in the supervision of the milk supply. The commissioner and one assistant give a part of their time to this work. During the past year 655 samples of milk and 115 samples of cream were examined by the Babcock test; 35 samples were examined bacteriologically; all dairy herds in the city and 73 of the 78 dairy farms were inspected.

Quincy. (Population, 36,252.)

[For comparison with other cities in Class III, see p. 34.]

William Hild, secretary of the board of health.

The daily consumption of milk is estimated as 1,500 gallons, or 0.33 pint per capita, besides 1,000 gallons of skimmed milk and 500 gallons of cream. This is sold from

30 stores and 20 wagons. Glass bottles, filled at the producing farms, are used by 3 dairies. Very little milk is pasteurized, and the practice seems to be increasing. Milk is retailed at 5 cents per quart throughout the year, and is supplied from 20 dairy farms, all within 5 miles of the city.

There is no supervision of the city milk supply.

Springfield. (Population, 34,159.)

[For comparison with other cities in Class III, see p. 34.]

Frank N. Patterson, sanitary inspector.

Estimated average daily consumption of milk is 2,500 gallons, or 0.59 pint per capita. Milk is sold from 4 stores and 48 wagons. Within the city limits there are 7 herds, including 63 cows, and milk is sent in from 28 dairy farms. About 6 per cent is received by rail, the longest shipment being 20 miles.

An ordinance adopted in July, 1897, regulates the milk supply. The health officer or sanitary inspector must make a thorough inspection of conditions existing at all premises where milk is sold. Annual license fee is $5, but "private persons" keeping 1 or more cows, and who sell to their customers by peddling same by hand, are exempt from license fee. Each milk wagon must bear a painted metal plate, furnished with the license. Adulterated milk or cream is prohibited. The milk standard is 12 per cent solids, 3 per cent fat; cream standard, 15 per cent fat. Skimmed-milk containers must be tagged with a metal plate, 3 by 5 inches in size. Hotel keepers, restaurant keepers, and boarding-house keepers are subject to the provisions of this ordinance, except the obtaining of a license.

During the past year 389 samples of milk were examined by lactometer and Babcock test; no bacteriological examinations were made; all the city herds, and 13 of the 28 dairy farms, were examined.

Rockford. (Population, 31,051.)

E. W. Brown, mayor.

This city has no milk inspector, and there is no supervision of its milk supply.

East St. Louis. (Population, 29,655.)

M. M. Stephens, mayor.

This city has no milk inspector, and information regarding its milk supply is not available.

Joliet. (Population, 29,353.)

[For comparison with other cities in Class III, see p. 34.]

John R. Casey, M. D., health commissioner.

The daily consumption of milk is estimated as 2,400 gallons, or 0.65 pint per capita, besides 15 gallons of cream. No skimmed milk is sold. Milk is sold from 8 stores and 55 wagons. Very little milk is delivered in glass bottles, and these are filled, some at the farms and some in the city. Only two dealers pasteurize milk and the practice is not increasing. The retail price is 5 cents per quart throughout the year, producers receiving 2½ cents. There is no herd near the city conducted in an entirely satisfactory manner. There are no city herds of milch cows. Milk is brought in wagons from 40 dairy farms within 5 miles of the city.

A city ordinance, May, 1897, requires dairymen to furnish to the health commissioner a description of all their milch cows, a sample of milk obtained therefrom, and a sample of the water used in washing milk cans, etc. All the herds must be tested with tuberculin. The milk standard, as given by the health commissioner, is 3 per cent fat; specific gravity, not less than 1.028.

Nothing is appropriated especially for the supervision of the milk supply. During the past year 300 samples of milk were examined by the lactometer, and all the dairy farms were inspected.

It is recommended that all cows should be subjected to the tuberculin test.

Aurora. (Population, 24,147.)

[For comparison with other cities in Class IV, see p. 40.]

J. W. MacDonald, health officer.

The daily consumption or milk is estimated as 1,500 gallons, or 0.50 pint per capita, besides 100 gallons of skimmed milk and 50 gallons of cream. Milk is sold from 14 stores and 43 wagons, and about three-fourths of it is delivered in glass bottles, which are filled in the city. About 10 per cent of the entire amount is pasteurized, and this practice is increasing. The retail price of milk is 5 cents per quart throughout the year, producers receiving 2½ and 3 cents, summer and winter, respectively. The milk from one "model dairy" near the city is sold for 12 cents per quart. Within the city there are 2 herds, including 40 cows, and milk is sent in from about 100 dairy farms, the most distant being 8 miles from the city.

An ordinance of November, 1897, consisting of 21 sections, refers especially to milk. Another ordinance, relating to food and drink, refers in general terms to milk. License for the sale of milk or cream is $5; each wagon after the first, $5; but persons owning not more than 2 cows are exempt. Impure, adulterated, etc., milk is prohibited. The milk standard is 12 per cent milk solids, 3 per cent fat; cream standard, 15 per cent fat. Condensed milk must be from pure milk and contain the right proportion of milk solids and fat. Skimmed milk must be labeled. Buttermilk is permitted if made from pure milk. Milk premises, utensils, etc., must be kept clean. Milk wagons must bear metal sign. Cows must be given pure food and water.

About $300 is expended annually in the supervision of the milk supply, one official giving a part of his time to this work. During the past year 314 samples were examined by lactometer and Babcock test; 15 samples were examined bacteriologically for tubercle bacilli; the city herds, but none of the dairy farms, were inspected.

Recent improvement is due to greater cleanliness obtaining at dairies and to the practice of pasteurizing. It is stated that all cows should be tested for tuberculosis and all dairies as to sanitary condition, and there should be a more frequent inspection of the milk.

Evanston. (Population, 19,259.)

[For comparison with other cities in Class IV, see p. 40.]

William R. Parkes, M. D., health commissioner.

The daily consumption of milk is estimated as 1,500 gallons, or 0.62 pint per capita. Milk is sold from 10 stores and 40 wagons, there being 23 dealers. Glass bottles, filled in the city, are used almost universally in the delivery of milk. No milk is pasteurized. The retail price is 6 cents in summer and 7 to 10 cents in winter, producers receiving 4 cents and 5 cents in the two seasons. The milk from two dairies, conducted on a better plan than others, is sold for 8 cents per quart in summer and 10 cents in winter. Within the city limits there are 7 herds, including 400 cows, and milk is sent in from 37 dairy farms. About 35 per cent is received by railway, the longest shipment being 75 miles.

City ordinances, Chapter XLVI, sections 653–681, refer to milk. License fee for the sale of milk or cream is $5 for each store and wagon; each additional wagon, $2. This does not apply to persons who own 1 or more cows and peddle milk to their neighbors. Impure, adulterated, etc., milk is prohibited. The milk standard is 13 per cent solids, 3 per cent butter fat; the cream standard is 15 per cent butter fat.

Skimmed milk must be labeled. Condensed milk and buttermilk must be from pure milk. Milk from diseased cows may be confiscated. Cow stables must be washed out at least once a week.

The health officer and the sanitary inspector give a part of their time to the supervision of the milk supply. During the past year 40 samples of milk were examined by the lactometer, Babcock test, and gravimetric analysis. No bacteriological examinations were made. All the city herds and 25 of the 37 dairy farms were inspected. Four herds were subjected to the tuberculin test and 6 cows were condemned.

It is stated that all tubercular cows should be disposed of, and the tuberculin test should be used for their detection.

Moline. (Population, 17,248.)

[For comparison with other cities in Class IV, see p. 40.]

Ed. Kittilsen, city marshal and health officer.

The daily consumption of milk is estimated as 577 gallons, or 0.27 pint per capita. Milk is sold from 1 store and 34 wagons, and a part of it is delivered in glass bottles, filled at the farms; none is pasteurized. The retail price is 5 cents per quart throughout the year, producers receiving 3 cents. There are no "model dairies" near the city. Within the city limits there is 1 herd (30 cows), and milk is sent from 30 dairy farms. The longest shipment of milk by railway is 10 miles.

The city has no milk ordinance.

During the past year 332 samples of milk were examined by the Babcock test, and 24 of the 30 dairy farms were inspected.

Ottawa. (Population, 10,588.)

[For comparison with other cities in Class IV, see p. 40.]

W. F. Weese, V. S., acting dairy inspector.

The daily consumption of milk is estimated as 600 gallons, or 0.45 pint, per capita. Milk is sold from 15 wagons, but from no stores. About one-fourth of it is delivered in glass bottles, which are filled at the farms; none is pasteurized. The retail price is 5 cents per quart in summer and 6 cents in winter, producers receiving 2½ and 3 cents in the two seasons. There are no "model dairies" near the city. Within the city limits there are 3 herds, including 25 cows, and milk is supplied from 13 dairy farms, all within a radius of 4 miles.

Revised ordinances adopted in June, 1899, and August, 1899, refer to milk. License fee for the sale of milk or cream is $1 for each cow. Cows must be free from contagious and infectious disease. Provision is made for the use of the tuberculin test.

Four hundred dollars is expended annually in the supervision of the milk supply, one official giving a part of his time to this work. During the past year 13 samples of milk were examined by the lactometer and Babcock test; no bacteriological examinations were made; all the city herds and 11 of the 13 dairy farms were inspected.

Recent improvements in the milk supply include an increase in the butter fat content, greater cleanliness in handling, and the removal of all tuberculous cows from dairy herds. Needed improvements stated include the enforcement of more stringent sanitary measures at the producing farms and the more frequent testing of milk.

INDIANA.

J. N. Hurty, M. D., secretary of the board of health, Indianapolis.

Horner's Revised Statutes, 1897—section 2071 refers to milk. It is unlawful to knowingly sell milk that is adulterated or skimmed, or milk from a cow that is diseased or fed upon deleterious foods, including the refuse of a distillery or brewery.

Acts of 1899—chapter 121 refers to foods. Its enforcement is charged to the State board of health. It forbids the sale of adulterated food, which is defined at length, and under its authority the State board of health has established the following standards and rules: Milk shall contain at least 3 per cent fat, 9 per cent other solids: no coloring matter or antiseptic is permitted; it shall not be sold when taken less than twenty-one days before or four days after calving, nor when from a cow that is diseased or fed upon damaged food.

The board of health has issued rules describing in detail conditions which should be found and methods which should be followed at dairies.

As no appropriation has been made for the enforcement of the food law, the State board of health has been unable to take action under its authority.

Indianapolis. (Population, 169,164.)

[For comparison with other cities in Class I, see p. 26.]

A. F. Zearing, clerk of the board of public health.

The daily consumption of milk is estimated as 12,000 gallons, or 0.57 pint per capita. It is estimated also that 8,000 gallons of skimmed milk and 4,000 gallons of cream are consumed daily. Milk is sold from 770 stores and 273 wagons. Glass jars are used almost exclusively in its delivery, and these are filled both on the farms and in the city. A small amount of milk is pasteurized and this treatment is increasing in favor. The retail price per quart is 5 cents in summer and 6 cents in winter, and the producers receive 2¼ and 3 cents in the two seasons. A large portion of the dairies are conducted in a very satisfactory manner. Twenty-five herds, including 180 milch cows, are within the city limits, and 250 dairy farms send milk into the city. Five per cent of the total supply is received by rail, the longest shipment being 40 miles.

Dairies must be licensed and observe certain regulations adopted by the board of public health and charities, January, 1896, under authority of ordinance No. 71, December, 1895. License fee for sale of milk is 50 cents. The regulations require that dairy stables be constructed and the work be conducted in a sanitary manner; the requirements are detailed, some of them being: All animals except dairy stock must be excluded from the stable or milk room; each cow must be allowed 500 cubic feet air space; each cow must be cleaned daily and be properly fed and watered; cans must be scalded daily; milk must be strained and cooled to 58° F. promptly after milking; no milk must be used from cows sixty days before or twelve days after calving; the board of health must be promptly notified of the discovery of disease; and the tuberculin test may be required on suspected cows, etc. The milk standard is 9 per cent solids not fat, 3 per cent fat.

Regulations governing dairies are shown in Appendix I (p. 171).

One thousand dollars is appropriated annually for the supervision of the city milk supply, and one inspector gives his entire time to this work. During the past year 850 samples of milk were examined by lactometer, Babcock test, and gravimetric analysis; 14 samples were examined bacteriologically, and the city milch cows and 204 of the 250 dairy farms were inspected.

The superior quality of the milk supply of Indianapolis is due in no small measure to a plan put in operation by the health officials a few years ago whereby the dairymen who kept their dairies up to the highest standard received special certificates of approval. These were helpful in obtaining new trade and were therefore generally sought after, with the result that sanitary methods were introduced into many places where they would not otherwise have been found. [a]

[a] Market Milk: A Plan for its Improvement. Seventeenth An. Rpt. Bu. An. Ind., pp. 158–193.

The most marked recent improvement has resulted from prosecutions for the use of formaldehyde[a] as a preservative, and in compelling greater cleanliness in the handling of milk.

Evansville. (Population, 59,007.)

[For comparison with other cities in Class II, see p. 30.]

J. H. Kerth, milk and food inspector.

The daily consumption of milk is estimated as 2,500 gallons, or 0.34 pint per capita. Milk is sold from 3 stores and 60 wagons. In the delivery of milk glass bottles are used by two dairy establishments. One of these fills the bottles in the city, the other at the producing farm. No milk is pasteurized. The average retail price of milk is about 6¼ cents per quart throughout the year. There is one well-conducted dairy near the city, but it receives no advance in price for its product. Within the city limits there are 5 herds of milch cows, including 60 head, and 54 dairy farms send milk into the city. No milk is shipped in by railway, the supply coming by wagons as far as 9 miles.

Ordinance No. 31, October, 1893, regulates the milk supply. License to sell milk is granted free of charge. Unwholesome or adulterated milk, "swill milk," and milk from unhealthy cows is prohibited. The inspector must inspect at least once a month all dairies, including cows, milk, vessels, etc.

Nine hundred dollars is expended annually in the supervision of the milk supply. One officer, as milk and food inspector, gives his entire time to this work. During the past year 215 samples of milk were examined by lactometer, the Babcock test for fat, and by a qualitative test for formaldehyde; no bacteriological examinations were made; all of the city herds and all the dairy farms were inspected.

Recently the sale of milk containing preservatives has decreased and greater cleanliness has obtained in the production of milk.

Suggested improvements as given, include a higher milk standard and a more frequent inspection of dairies and dairy products.

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[a] Regarding the use of formaldehyde as a preservative in milk, the following statement, attributed to Dr. Morrison, health officer of Indianapolis, is reprinted:

My experiments were undertaken by reason of some prosecutions here for the sale of adulterated milk. Total number of experiments, 96; preservative, formaldehyde. Milk was secured direct from the cow and immediately transferred to test tubes. In each test tube was placed 6 c. c. of this milk. The tubes were placed upon racks in rows, each row containing a "control" tube, five tubes in each row, so that the average result could be obtained.

In row No. 1, pure milk; all other rows, one pure and four adulterated. To one row was added artificial gastric juice, prepared from Fairchild's pepsin. Exactly the same in same amounts applied to each of the tubes in other rows. Previous to putting in the digestive material, however, four tubes in each row were adulterated as follows: Second row, quantity equal to 9 drops of a 40 per cent solution of formaldehyde for each gallon of milk, and decreasing the per cent in each row until the last had an amount equal to one drop per gallon.

The first effect noted was that the coagulation which normally occurs in milk upon the addition of "rennin" in the ordinary commercial pepsin, was slightly retarded, the retardation being directly proportionate to the amount of formaldehyde used. When coagulation did occur the coagulum was tough in proportion to the amount of formaldehyde present, proving to my satisfaction that the coagulum formed by the digestive juice in the presence of formaldehyde was an exceedingly tough one. Next, tubes were placed in an incubator, kept there at a temperature of 100° F. for 8 hours and then examined. I give briefly the result without burdening with weights of undigested residue, etc.: Pure milk in all tubes, fully digested; where large amounts of formaldehyde were present absolutely no digestion. When the amount of formaldehyde present approached three drops to the gallon, digestion commenced and gradually increased as the porportion of the preservative decreased, but in the presence of one drop to the gallon the inhibitory action upon digestion could be seen.

Fort Wayne. (Population, 45,115.)

[For comparison with other cities in Class III, see p. 34.]

L. Park Drayer, city sanitarian.

The daily consumption of milk is estimated as 2,480 gallons, or an average of 0.44 pint per capita. Milk is sold from 15 stores and 106 wagons. Within the city limits there are 297 cows in 175 stables, and milk is brought to the city in wagons from 84 dairy farms, the longest haul being 8 miles.

General ordinance No. 128 regulates the milk supply. License fee for the sale of milk or cream is $1. The city bacteriologist is placed in charge of the milk division of the department of health. Adulterated, etc., milk or cream is prohibited. Boarding-house keepers, etc., furnishing milk or cream are subject to the provisions of this ordinance. The milk standard is 12 per cent solids, 3.5 per cent fat. Cream standard is 18 per cent fat. Skimmed milk containers must be painted red and be plainly labeled. Buttermilk must be from pure milk or cream. It is the duty of an officer of the board of health to examine as often as necessary all stables where cows are kept.

Ordinance section regarding delivery of skimmed milk is given in Appendix I (p. 179).

During the past year 700 samples of milk were examined by the Babcock test; no bacteriological examinations were made; all the city herds and all the dairy farms were inspected.

Terre Haute. (Population, 36,673.)

[For comparison with other cities in Class III, see p. 34.]

C. O. Elliott, city inspector.

The daily consumption of milk is estimated as 1,000 gallons, or 0.22 pint per capita, besides 40 gallons of skimmed milk and 30 gallons of cream. Milk is sold from 9 stores and 25 wagons. Fifty per cent of the dairies supply milk in glass bottles, filled at the farms. A large quantity of milk is pasteurized, and the practice is increasing. Milk is retailed at 5 cents per quart throughout the year, the producers receiving 3½ cents. The milk from one "model dairy" near the city is sold regularly for 10 cents per quart. Thirty-four dairy farms send milk into the city. Only a very little milk is received by railway, the longest shipment being 30 miles.

About $1,200 is expended annually in the supervision of the milk supply, one official giving his entire time to this work. During the past year 500 samples were examined by the lactometer and Babcock test and were tested for preservatives, and all the dairy farms were inspected.

South Bend. (Population, 35,999.)

[For comparison with other cities in Class III, see p. 34.]

C. M. Butterworth, commissioner of health.

The daily consumption of milk is estimated as 1,000 gallons, or 0.22 pint per capita. Milk is sold from 35 wagons. About one-third of the milk is delivered in glass bottles, filled at the producing farms. No milk is pasteurized. The retail price of milk is 5 cents per quart in summer and 6 cents in winter. There are no "model dairies" near the city. There are no dairy herds within the city limits. Milk is sent in from 25 dairy farms. About 2 per cent is received by railway, the longest shipment being 15 miles.

During the past year 28 samples were tested for preservatives; no bacteriological examinations were made, and no herds were inspected.

Richmond. (Population, 18,226.)

[For comparison with other cities in Class IV, see p. 40.]

George G. Ferling, V. P. S., dairy inspector.

The daily consumption of milk is estimated as 1,250 gallons, or 0.55 pint per capita. Milk is sold from about 15 stores and 39 wagons, and one-third of it is delivered in glass bottles, filled at the farms. Milk is pasteurized at one dairy farm, but the practice is not increasing. The retail price is 5 cents per quart throughout the year. A few dairies near the city are conducted in a better manner than others, but receive no advance in price for their product. There are 4 herds, including 45 cows, within the city limits, and milk is sent from 36 dairy farms, all within 6 miles of the city.

There is expended annually $150 in the supervision of the milk supply, one official giving a part of his time to this work. During the past year 38 samples of milk were examined by the Babcock test, all the city herds were inspected monthly, and all the dairy farms were inspected.

Recently there have been more cleanly methods in dairies and more care in the cooling of milk. Further improvements, as given, include the proper cleaning of stables and cows, a pure water and food supply, and the delivery of milk in bottles.

IOWA.

H. R. Wright, dairy commissioner, Des Moines, successor to B. P. Norton (1903).

Code of 1897, title 12, chapter 13, sections 2522 to 2528, and title 24, chapter 10, sections 4989 to 4991, refer to market milk. They are enforced by the State dairy commissioner. City milk dealers and persons supplying them must keep premises and utensils in hygienic condition and must report statistics to the dairy commissioner. Every person using a milk test shall obtain certified glassware from the dairy commissioner. An agent may be placed in each city of over 10,000 inhabitants to collect and test milk samples. A permit to sell milk must be obtained for each wagon, depot, or store; all permits expire every July 4, and cost $1 annually. The sale of impure or adulterated milk, or milk from a diseased cow or one having ulcers or sores, or milk from a cow within fifteen days before or five days after parturition, is forbidden. No person shall keep cows for production of market milk or cream in an unhealthy place nor shall knowingly give them food which produces impure milk, or feed them distilled glucose or brewery waste in a state of fermentation, or any putrefying or unhealthy substance. The milk standard is 12.5 per cent solids, 3 per cent fat; cream standard, 15 per cent fat. Skimmed milk may be sold as such.

An amendment (General Acts, 1902, chapter 102, section 1), places a penalty on creameries, etc., which do not report statistics to the dairy commissioner.

Inspection is now conducted under the direction of the dairy commissioner in 14 cities. The work of the local inspectors consists entirely of an inspection as to sanitary conditions of milk and the wagons and cans used in its delivery, and the testing of milk and cream samples for fat content. During the last year 784 store and wagon licenses to sell milk were issued, and about 12,000 tests of milk and cream were made by the commissioner's agents; a number of examinations for preservatives were made. Work in 1900 was carried on under difficulties due to adverse court decisions which have since been reversed. The total time expended in their work by the 14 milk inspectors is equivalent to perhaps sixty days a month; they are paid $3 per day for their services.

The form for application for milk license is shown in Appendix IV (p. 190).

Des Moines. (Population, 62,139.)

[For comparison with other cities of Class II, see p. 30.]

B. P. Norton, State dairy commissioner.

The daily consumption of milk is estimated as 5,000 gallons, or 0.64 pint per capita. This is sold from 40 stores and 125 wagons. Ten per cent of the milk is delivered in glass bottles, some of which are filled at the farms and some in the city. No milk is pasteurized. The retail price of milk is 5 cents per quart throughout the year, producers receiving 2 cents per quart in summer and 2½ cents in winter. There are no "model dairies" in or near the city. There are 75 herds, including 1,000 cows, within the city, and 100 dairy farms send milk into the city. A portion of the cream shipped by railway comes a distance of 40 miles.

The city has no milk ordinance and provides no specific fund for the supervision of its milk supply, this work being under State control with an appropriation of $300. One State official gives eight days each month to this work. During the past year about 1,000 samples of milk were examined by the Babcock test; no bacteriological examinations were made.

Recently there has been a decrease in the use of preservatives in milk.

Dubuque. (Population, 36,297.)

[For comparison with other cities in Class III, see p. 34.]

B. P. Norton, State dairy commissioner.

The amount of milk sold daily is estimated as 1,425 gallons, or 0.31 pint per capita, besides 150 gallons of cream. The above estimate does not include the milk from cows kept by private families in the city. Milk is sold from 12 stores and 45 wagons. Very little milk is delivered in glass bottles, and none is pasteurized. The retail price is 5 cents per quart throughout the year, producers receiving 2 cents and 2½ cents in the two seasons. There are no dairies near the city conducted in an entirely satisfactory manner. The milk from 40 dairy farms is brought to the city in wagons, the longest haul being 10 miles.

The city expends nothing in the supervision of its milk supply. The State dairy commission expends annually about $144, one official giving four days of each month to this work. During the past year 5,000 samples of milk were examined by the Babcock test; none of the dairy farms were inspected.

Davenport. (Population, 35,254.)

[For comparison with other cities in Class III, see p. 34.]

C. H. Preston, city physician.

The daily consumption of milk is estimated as 1,400 gallons, or 0.32 pint per capita, besides 500 gallons of skimmed milk and 150 gallons of cream. Milk is sold from 3 stores and 64 wagons. Glass bottles, filled at the farms, are used largely in the delivery of milk. Little if any milk is pasteurized. The retail price of milk is 5 cents per quart throughout the year, the producers delivering their milk at the above price. Within the city limits there are 14 herds, including 239 cows, and milk is brought in wagons from 52 dairy farms within a radius of 6 miles from the city.

An ordinance, passed in December, 1896, refers to milk. Each dairy and dairy herd must be inspected by an officer of the board of health previous to the issuing of a license for the sale of milk therefrom. The tuberculin test is authorized. Inspected animals are tagged.

During the past year $600 (city $400, State $200) was expended in the supervision of the milk supply. One milk and health inspector and one food and dairy inspector

give a part of their time to this work. One thousand milk samples were examined by the Babcock test, and five samples by gravimetric analysis; no bacteriological examinations were made. All city herds and dairy farms were inspected twice. Although there is no "model dairy" near the city, it is stated that all dairies "are conducted with care under inspection."

Recently dairies have improved in cleanliness, and the use of bottles has increased. It is stated that the milk supply might be further improved if examination of samples could be made in district bacteriological and chemical laboratories established by the State.

Sioux City. (Population, 33,111.)

[For comparison with other cities in Class III, see p. 34.]

O. P. McCray, agent of the dairy commission.

The daily consumption of milk is estimated as 4,500 gallons, or 1.09 pints per capita. Milk is sold from 10 stores and 46 wagons. Glass bottles, filled at the producing farms, are used to a limited extent in the delivery of milk, and this practice is increasing. No milk is pasteurized. The retail price of milk is 5 cents per quart in summer and 6 cents in winter. There are no "model daries" near the city. Within the city limits there are 41 herds, including 610 cows, and milk is brought in wagons from dairy farms within 6 miles of the city.

The State expends annually about $144 in the supervision of the city milk supply, one official giving a part of his time to this work. During the past year 720 samples of milk were examined by the Babcock test; no bacteriological examinations were made; none of the city herds were inspected.

Council Bluffs. (Population, 25,802.)

[For comparison with other cities in Class III, see p. 34.]

W. A. Groneweg, city milk inspector.

The daily consumption of milk is estimated as 1,600 gallons, or 0.49 pint per capita, besides 50 gallons of skimmed milk and 250 gallons of cream. Milk is sold from 6 stores and 31 wagons. About one-half of the dealers use glass bottles for delivering milk; these are filled both on the farms and in the city, and their use is increasing. Nearly one-third of the milk is pasteurized, but this practice is not increasing. The retail price of milk is 5 cents per quart in summer and 6 cents in winter, the producers receiving 2½ cents throughout the year. There are no "model dairies" near the city. Within the city limits there are 22 herds, including 300 cows, and milk is sent in from 5 (?) dairy farms. One-third of the total supply comes in by railway, the longest shipment being 7 miles.

One official of the State dairy commission gives a part of his time to the supervision of the milk supply. During the past year milk samples were collected and examined by the Babcock test three or four times every month; no bacteriological examinations were made; none of the dairy herds were inspected.

The greatest recent improvement has been in the increased use of glass bottles, which are both convenient and cleanly. It is suggested that all herds, barns, dairy buildings, etc., should be inspected once each month, and that all milk and cream be delivered in bottles, or small cans, so as to avoid unnecessary contamination by dust, etc.

Cedar Rapids. (Population, 25,656.)

[For comparison with other cities in Class III, see p. 34.]

J. W. Griffith, V. S., city milk inspector.

The daily consumption of milk is estimated as 1,500 gallons, or 0.47 pint per capita, besides 400 gallons of skimmed milk and 200 gallons of cream. Milk is sold

from 35 stores and 40 wagons. Glass bottles, filled mostly at the farms, are used by one-half of the milkmen. Milk was pasteurized by one dealer, but, on account of the small demand for it, the practice has been discontinued. The retail price is 4 to 5 cents per quart throughout the year, the producers receiving 2 to 3 cents in summer and 3 to 4 cents in winter. There is no dairy near the city which is conducted in an entirely satisfactory manner. Within the city limits there are 8 herds, including 200 cows. No milk is received by railway. The most distant source of supply is 12 miles from the city.

The city expends nothing for milk inspection work, this being done by the State dairy commission, one official giving a part of his time to this work at a cost to the State of $150. During the past year milk samples were examined by the Babcock test; no bacteriological examinations were made, and none of the dairy farms were inspected.

Recently the milk supply has improved, due to greater cleanliness at the producing farms. It is suggested that all milch cows be tested with tuberculin.

Burlington. (Population, 23,201.)

[For comparison with other cities in Class IV, see p. 40.]

W. C. Hummell, health officer and milk inspector.

The daily consumption of milk is estimated as 1,600 gallons, or 0.55 pint per capita. Milk is sold from 1 store and 44 wagons. One firm delivers milk in sterilized glass bottles, which are filled in the city. No milk is pasteurized. The retail price is 5 cents per quart in summer and 6 cents in winter. There are no "model dairies" near the city. Within the city limits there are 50 herds, including 1,200 cows. Milk is sent in from 12 dairy farms, the most distant being 20 miles from the city.

A city ordnance gives the health officer power to prosecute under State law and to prohibit the sale of impure or adulterated milk.

Nothing is appropriated by the city for the supervision of its milk supply, this work being under State control. During the past year 600 samples of milk were examined by the Babcock test; no bacteriological examinations were made; 35 of the 50 city herds, but none of the dairy farms, were inspected.

Needed improvements, as given, include thorough inspections of milk and dairies, such inspections to be made often until the character of the supply is satisfactory.

Clinton. (Population, 22,698.)

[For comparison with other cities in Class IV, see p. 40.]

B. P. Norton, State dairy commissioner.

The daily consumption of milk is estimated as 1,000 gallons, or 0.35 pint per capita, besides 60 gallons of cream. In explanation of this apparently low consumption it is stated that many families keep their own cows and the milk from these is not included in the above estimate. Milk is sold from 10 stores and 30 wagons. Very little milk is delivered in glass bottles, filled at the farms and in the city; none is pasteurized. The retail price is 5 cents per quart throughout the year, producers receiving 2 cents in summer and 2½ cents in winter. There are no so-called "model dairies" near the city. Milk is sent in from 30 dairy farms, the most distant being 10 miles from the city.

The city milk supply is under State supervision. During the past year 4,000 samples of milk were examined by the Babcock test.

Recent improvement is due to the decreased use of preservatives.

Ottumwa. (Population, 18,197.)

[For comparison with other cities in Class IV, see p. 40.]

E. B. Hill, milk agent.

The daily consumption of milk is estimated as 606 gallons, or 0.27 pint per capita, besides 15 gallons of skimmed milk and 12 gallons of cream. In explanation of this small consumption, it is stated that there are 200 cows kept by private families in the city, and the milk from these is not included in the above estimate. Milk is sold from 1 store and 18 wagons. Only a few bottles are used in the delivery of milk, and these are filled at the farms. No milk is pasteurized. The retail price is 5 cents per quart in summer and 6 cents in winter, producers receiving 2½ cents and 3 cents in the two seasons. There are no so-called "model dairies" near the city. Within the city there is one herd (12 cows), and milk is sent in from 20 dairy farms within a radius of 10 miles. About 8 per cent is received by railway.

During the past year 576 samples of milk were examined by the Babcock test; 1 bacteriological examination for typhoid bacilli; 1 of the 20 dairy farms was inspected.

Keokuk. (Population, 14,641.)

[For comparison with other cities in Class IV, see p. 40.]

Frank Harshman, deputy State dairy commissioner.

The daily consumption of milk is estimated as 500 gallons, or 0.27 pint per capita, besides 30 gallons of skimmed milk and 50 gallons of cream. Milk is sold from 20 stores and restaurants and 16 wagons. Glass bottles are not used, and no milk is pasteurized. The retail price is 5 cents per quart in summer and 6¼ cents in winter, producers receiving 4 and 5 cents in the two seasons. There are no "model dairies" near the city. About 500 cows in the city and on 16 dairy farms produce the milk supply. The most distant dairy farm is 4 miles from the city.

About $126 is expended annually as the salary of one State official, who gives a part of his time to this work. During the past year 432 samples of milk were examined by the Babcock test; no bacteriological examinations were made; all city cows and all dairy farms were inspected.

Recent improvement in the milk supply is due to a better grade of cows and more careful feeding.

It is stated that milk should be delivered in bottles filled at the farms.

Marshalltown. (Population, 11,544.)

[For comparison with other cities in Class IV, see p. 40.]

E. M. Singleton, M. D., city milk inspector.

The daily consumption of milk is estimated as 800 gallons, or 0.55 pint per capita, besides 100 gallons of skimmed milk and 20 gallons of cream. Milk is sold from 1 store and 14 wagons, and about one-half of it is delivered in glass bottles filled at the farms; none is pasteurized. The retail price is 4 to 5 cents per quart in summer and 5 to 6 cents in winter, producers receiving 2½ cents per quart. There are no "model dairies" near the city. Within the city there are 2 herds, including 35 cows, and milk is sent in from 12 dairy farms within a radius of 3 miles.

About $110 is expended annually in the supervision of the milk supply as the salary of one State official, who gives a part of his time to this work. During the past year 500 samples of milk were examined by the Babcock test.

It is stated that dairies should be inspected, and that cleanly methods be required.

KANSAS.

General Statutes, 1897, volume 2, sections 322 to 331, refer to milk and food. The sale of adulterated and skimmed milk with intent to defraud, or the sale (knowingly) of the product of diseased animals, is forbidden. It is unlawful to sell food which is adulterated, this term being defined at length.

Kansas City. (Population, 51,418.)

[For comparison with other cities of Class II, see p. 30. See also Kansas City, Mo.]

Jacob S. Heisey, inspector of licenses, weights, measures, and milk.

The daily consumption of milk is estimated as 3,000 gallons, or 0.47 pint per capita, besides 165 gallons of cream. In addition to the above, 4,000 gallons of milk is used daily by six oleomargarine manufacturers. Milk is sold from 100 stores and 75 wagons. Glass bottles are not used in delivering milk. During the summer months fully 80 per cent of the milk is pasteurized. The retail price of milk is 5 cents per quart throughout the year. There are no "model daries" in this vicinity. Within the city limits there are 42 herds, including 1,000 head of cattle. A part of the city milk supply comes 40 miles by railway.

Ordinance No. 3720, August, 1899, refers to milk. Persons selling milk must have permit. Adulterated, diseased, etc., milk is prohibited. Inspector must inspect all dairies and dairy cows within the city limits during the months of April and October, and he may inspect dairies beyond the city limits on payment of $2 each and 5 cents per mile. The milk standard is 12 per cent solids, 3 per cent fat. Condensed milk, buttermilk, sour milk, or skimmed milk must be properly labeled and be from pure, wholesome milk.

Besides expenses borne by the license department, about $100 is paid each year to a veterinary surgeon for assistance in examining herds. No milk samples were examined during the past year, but all the city herds and 10 dairy farms were inspected.

The form for notice which must be sent to the inspector when cows are added to a dairy herd is shown in Appendix IV (p. 199).

Recent improvement has been made in the quality of milk by the introduction of cows producing rich milk.

Topeka. (Population, 33,608.)

[For comparison with other cities in Class III, see p. 34.]

J. P. Farnsworth, city food inspector.

The daily consumption of milk is estimated as 2,000 gallons, or 0.48 pint per capita, besides 50 gallons of skimmed milk and 80 gallons of cream. This is sold from 20 stores and 50 wagons. Five per cent of the milk is delivered in glass bottles, which are filled in the city; none is pasteurized. The retail price is 5 cents per quart in summer and 5 to 6¼ cents in winter, producers receiving 2½ cents in summer and 2½ to 3½ cents in winter. The milk from one "model dairy" near the city is sold for 8¼ cents per quart and higher. Within the city limits there are 4 herds, including 60 cows, and milk is brought to the city in wagons from 150 dairy farms within a radius of 10 miles.

Ordinances No. 620, of May, 1886, and No. 802, of April, 1888, refer to milk. The food inspector (salary $900) must inspect the milk supply. Persons selling milk must register with the board of health. Adulterated, etc., milk is prohibited. Milk from cows fed on refuse from starch factory, vinegar factory, or glucose factory is prohibited. The milk standard is 12 per cent solids, 3 per cent fat. Skimmed milk must be labeled.

About $1,000 is expended annually in the supervision of foods, the inspector giving a part of his time to the milk supply. During the past year about 400 samples of milk were examined by the Babcock test; no bacteriological examinations were made; all the city herds and nearly all the dairy farms were inspected.

It is stated that the milk supply would be very much improved if producers would not aerate their milk in or near barns.

KENTUCKY.

Acts of 1891, 1892, and 1893, chapter 182, section 144, refer to milk. It is unlawful to knowingly sell milk that is adulterated, or from a diseased cow or from a cow fed upon still slop, brewers' slop, or brewers' grains. Skimmed milk shall not be sold with intent to defraud.

Acts of 1900, chapter 13, refers to foods. It forbids the sale of a food which is adulterated or contains an antiseptic or preservative, unless same is branded "adulterated," and sold for what it is. The State agricultural experiment station may inspect and analyze foods, adulterated products to be reported to the Commonwealth attorney of the district, or county attorney, or city attorney for prosecutions. The director of the agricultural experiment station is empowered to fix standards of purity, etc., and has published the following: Milk, 12 per cent solids, 3 per cent fat; cream, 15 per cent fat; both of these to be free from preservatives or coloring matter.

Louisville. (Population, 204,731.)

[For comparison with other cities in Class 1, see p. 26.]

M. K. Allen, M. D., health officer.

The daily consumption of milk is estimated as 10,000 gallons, or 0.39 pint per capita, besides 8,000 gallons of skimmed milk and 50 gallons of cream. Milk is sold from 100 stores and 250 wagons. Possibly one-fourth of the milk is delivered in glass bottles, which are filled on the producing farms. Only a small amount of milk is pasteurized, but the practice is increasing. The retail price of milk is 5 to 6¼ cents per quart throughout the year, producers receiving 3 cents per quart in summer and 3½ cents in winter. There are three or four especially well-conducted dairies near the city which retail their product as high as 7½ cents per quart. Within the city limits there are about 100 herds, including 1,000 cows. There are also about 100 dairy farms sending milk into the city. It is estimated that one-half of the total milk supply is shipped by railway, the longest shipment being 50 miles.

Ordinance No. 108, series 1898, adopted in May, regulates the milk supply. Each person sending milk into the city must have a permit from the health officer, granted in January of each year, free of charge. Permit numbers must be shown on wagons, and names of dairymen supplying milk must be shown in stores, etc., where it is sold. Permit holders must furnish, once every three months, a certificate from a veterinarian to the effect that all his milch cows are free from disease. The tuberculin test may be required in any herd suspected of infection with tuberculosis. Each cow must have 600 cubic feet air space, and all dairy buildings must be well constructed and painted or whitewashed. The standard for milk is 12 per cent milk solids, 3 per cent fat, and a specific gravity not less than 1.029; cream must contain 20 per cent of butter fat. The sale of unwholesome or adulterated milk is prohibited, including milk from cows within fifteen days before or ten days after calving, from cows fed on distillery waste or any fermenting substance or given any unwholesome food or drink, or from cows kept in a crowded or unhealthy condition, milk from which any part of the cream has been removed, and milk to which any foreign substance has been added. Skimmed milk may be sold, if plainly labeled, and if it contains the normal amount of casein and salts. Bottled milk must not be delivered to, nor empty bottles taken from, any dwelling where there is a contagious

disease, and no person who has been exposed to a contagious disease shall work in a dairy. Dairy employees must maintain strict cleanliness. Manure must be removed twice daily, one hour preceding each milking. The teats and, if necessary, the udders must be carefully cleaned before milking. All apparatus used in handling milk must be of nonabsorbent material and be kept clean at all times. When milk vessels are filled they shall be promptly removed from the stable and not stored in a room where animals are kept. The health officer must be notified within twenty-four hours after the discovery of a contagious or infectious disease among the cows. Diseased cows must be isolated.

The full text of the milk ordinance is shown in Appendix I (p. 169).

The city does not provide a specific fund for the supervision of the milk supply. Three sanitary inspectors of the health department occasionally give attention to this part of the food supply. During the past year 475 samples of milk were analyzed, and about 25 of the 100 city herds and 25 of the 100 dairy farms were inspected; no bacteriological examinations were made.

Marked improvement has been made in the sanitary condition of the dairies. Further needs, as given, include close attention to the sanitary condition of the dairies, the use of the tuberculin test, and bacteriological examinations of the milk.

Covington. (Population, 42,938.)

[For comparison with other cities in Class III, see p. 34.]

Charles W. Reynolds, health officer.

The daily consumption of milk is estimated as 3,500 gallons, or 0.65 pint per capita. This is sold from 140 stores and 36 wagons. Two firms deliver milk in glass bottles, these being filled at the producing farms. The same firms pasteurize milk and the demand for milk so treated is increasing. Milk is retailed at 6 to 8 cents per quart throughout the year; the milk from one "model dairy" is sold regularly at 8 cents. There are no dairy herds within the city limits. Milk is sent in from 31 dairy farms, all within 9 miles of the city.

During the past year 372 samples of milk were examined by the lactometer and Babcock test; no bacteriological examinations were made; all the dairy farms were inspected.

Newport. (Population, 28,301.)

No reply to inquiries was received.

Lexington. (Population, 26,369.)

[For comparison with other cities in Class III, see p. 34.]

F. O. Young, M. D., president of the board of health.

The daily consumption of milk is estimated as 2,000 gallons, or 0.61 pint per capita, besides 258 gallons of skimmed milk and 178 gallons of cream. Milk is sold from 10 stores and 48 wagons. Ninety per cent of the milk is delivered in glass bottles filled at the farms. About one-third of the supply is pasteurized, and this practice is increasing. The retail price of milk is 5 cents per quart in summer and 6⅔ cents in winter, producers receiving 3½ cents and 3¾ cents, respectively. Milk is brought to the city in wagons from 39 dairy farms, the longest haul being 7 miles.

The city has no milk ordinance and exercises no supervision over its milk supply.

LOUISIANA.

Acts of 1882, No. 82, refers to foods. It forbids the sale of adulterated food, which term is defined at length. It is the duty of the State board of health to investigate foods.

New Orleans. (Population, 287,104.)

[For comparison with other cities in Class I, see p. 26.]

Quitman Kohnke, M. D., health officer.

The daily consumption of milk is estimated as 9,609 gallons, or 0.27 pint per capita, besides 200 gallons of skimmed milk and 75 gallons of cream. Milk is distributed from 17 stores and 410 wagons. A few venders use glass bottles in their trade. A small amount of milk is pasteurized, and this treatment is increasing in favor. The retail price of milk is 7½ cents per quart both in summer and winter, producers receiving 2¾ cents. There are 3 "model dairies" in the vicinity which sell their product for 10 cents per quart during the entire year. There are 440 dairy herds, including 6,686 cows, within the city limits, producing 86 per cent of the total supply, and 69 dairy farms send milk into the city, the longest shipment being 83 miles.

Several city ordinances relate to the milk supply. The principal one appears to be No. 16204, adopted in May, 1890; others are 4627 of 1890, 6596 of 1892, and 7581 of 1893. It is required that a permit be obtained for the production or sale of milk or other dairy product to be used as food in the city. This is issued by the board of health, free of charge, and only after certain detailed information regarding the source of the milk and the conduct of the proposed business has been filed; it is revocable for cause. Permit number and name of supplying dairy, etc., must appear on delivery wagons. The requirements for dairy stables and milk rooms are given in considerable detail, some of them being that all dairy buildings must be constructed in a sanitary manner, properly equipped, and well cared for; 600 cubic feet of air space must be allowed for each animal; milk appliances must be of nonabsorbent material; milk cans must be removed from the stable promptly when filled and be thoroughly scalded when cleaned; refrigerators must be constructed and located in a particular manner; milk must not be stored in a room where animals are kept; bottles must not be delivered to nor taken from any place where there is a contagious disease; bottles must not be filled on delivery wagons; stock must not be given impure water, nor fed on brewery grain or other unhealthy food; cows must be rejected if diseased and the tuberculin test must be used in their examination; healthy cows must be tagged; employees must be personally cleanly and healthy and not recently exposed to disease. The milk standard is 13 per cent solids, 9½ per cent solids not fat, 3½ per cent fat; specific gravity, at 60° F., 1.029. Adulterated milk, milk to which any foreign substance has been added, or milk from unhealthy cows is prohibited. Skimmed milk may be sold if in plainly labeled vessels. No liquid other than milk or cream shall be carried in a milk wagon.

The supervision of the milk supply is included in the work of the food inspection department and its expense to the city is not kept separately. In the department named there is one chief (a veterinarian), whose salary is $1,500, and 13 assistants paid $600 each. These officers inspect dairies and collect milk samples for the chemist, whose salary is $1,300. During the past year 1,141 samples of milk were examined by the Babcock test, pycnometer, or gravimetrically; 2 bacteriological examinations were made for tubercle bacilli; all the dairy herds within the city and 27 of the 69 dairy farms were inspected.

Milk "runs" are made at frequent irregular intervals. The officer is supplied with a known number of bottles with perforated necks and the same number of perforated lead seals, also short wires and a clamp. Samples must be sealed in the presence of the vender. The number of lead seals used and unused are checks on each other. The lead seals may be marked by venders if desired. (This method is explained here in detail because it differs from the one usually practiced by which samples are taken in duplicate, one being left with the vender for analysis or disposition as he chooses.)

It is said the average quality of the milk sold in the city has recently shown marked improvement.

MAINE.

Revised Statutes of 1883, chapter 38, sections 44 to 47, amended in 1887, 1893, and 1897, and Public Laws of 1895, chapter 144, section 1, refer to milk. Milk inspectors shall be appointed in towns of more than 3,000 inhabitants, and may be appointed in smaller towns. They are required to keep a record of the names and addresses of all milk dealers, and may inspect places and vehicles where milk is sold and take samples for analysis. It is unlawful knowingly to sell milk from cows having tuberculosis or other disease or fed upon the refuse of breweries or distilleries or other deleterious substance, or milk to which water or any foreign substance has been added. The milk standard is 12 per cent solids, 3 per cent fat. Skimmed milk must not be sold for pure milk. Milk must be sold by wine measure, and measures must be sealed annually.

Public Laws of 1895—chapter 169 requires that milk tests, for basis of payments, shall be accurate.

Portland. (Population, 50,145.)

[For comparison with other cities in Class II, see p. 30.]

W. C. G. Carney, health inspector.

The daily consumption of milk is estimated as 3,000 gallons, or 0.48 pint per capita. Milk is sold from 200 stores and 75 wagons. About one-fourth of the milk is delivered in glass bottles which are filled in the city. Little or no milk is pasteurized. The retail price of milk is 6 cents per quart in summer and 7 cents in winter, producers receiving 3 cents in summer and 4 cents in winter. A few dairies near the city, better conducted than others, receive a slight increase in price for their product. Within the city limits there are 19 herds of milch cows, including 134 head, and milk is sent into the city from 40 dairy farms. About three-fourths of the total milk supply is received by railway, the longest shipment being 48 miles.

The city has no milk ordinance and expends nothing in the supervision of its milk supply, therefore no inspection work has been done.

Lewiston. (Population, 23,761.)

[For comparison with other cities in Class IV, see p. 40.]

James H. Goddard, milk inspector.

The daily consumption of milk is estimated as 1,800 gallons, or 0.61 pint per capita. Milk is sold from 10 stores and 75 wagons. Glass bottles, used only to a small extent, are filled at the farms. About 500 gallons are pasteurized daily; the practice is not increasing. The retail price is 6 cents per quart throughout the year, the producers receiving 3 cents. There are no "model dairies" near the city. Within the city limits there are 25 herds, and milk is sent in from 50 dairy farms within a radius of 5 miles.

State statutes regulate the sale of milk.

About $200 is expended annually in the supervision of the milk supply, one official giving a part of his time to this work. During the past year about 300 milk samples were examined by gravimetric analysis; no bacteriological examinations were made; 15 city herds and 10 of the 50 dairy farms were inspected.

Waterville. (Population, 9,477.)

[For comparison with other cities in Class IV, see p. 40.]

A. Joly, D. V. S., milk inspector.

The daily consumption of milk is estimated as 800 gallons, or 0.68 pint per capita, besides 100 gallons of skimmed milk and 50 gallons of cream. Milk is sold from 15

stores and 39 wagons, and a number of private families sell milk to their neighbors. About 75 per cent of the supply is delivered in glass bottles filled at the farms; none is pasteurized. The retail price is 5 cents per quart in summer and 6 cents in winter. There are four dairies conducted on a considerably better plan than others, but they receive no advance in price for their product. Within the city limits there are 8 herds, including 75 cows, and milk is brought in wagons from 39 dairy farms, the longest haul being 8 miles.

State laws regulate the sale of milk.

One hundred dollars is expended annually in the supervision of the milk supply, one official giving a part of his time to this work. During the past year 160 samples of milk were examined by the lactometer and Babcock test; no bacteriological examinations were made; all the city herds and all the dairy farms were inspected.

The milk inspector's report for 1899 shows that out of 201 samples examined 7 were found to be below the standard, and these were from grocery stores where the milk was not mixed before sales. Thirty-four dairies were inspected, the inspection consisting of a physical examination of each cow and an examination of the water supply, drainage, ventilation, etc. Two herds were tested with tuberculin and found to be free from tuberculosis.

Recent improvement in the milk supply is due to better barns, cows, and sanitary conditions.

Belfast. (Population 4,615.)

[For comparison with other cities in Class IV, see p. 40.]

W. L. West, M. D., milk inspector.

The daily consumption of milk is estimated as 300 gallons, or 0.52 pint per capita, besides 20 gallons of skimmed milk and 5 gallons of cream. Milk is sold from 6 stores and 12 wagons. About one-half of it is delivered in glass bottles, filled at the farms, and the portion thus served is increasing. No milk is pasteurized except by consumers after delivery. The retail price is 5 cents per quart in summer and 6 cents in winter. There are no "model dairies" near the city. Within the city limits there are 5 herds, including 125 cows, and milk is brought in wagons from 30 dairy farms, the longest haul being 8 miles.

About $50 is expended by the city in the supervision of its milk supply, one official giving a part of his time to this work. During the past year 150 samples of milk were examined by lactometer, Babcock test, and gravimetric analysis; no bacteriological examinations were made; each dairy farm was inspected every month.

Recent improvement is shown in the feeding of cows and the handling of milk. Needed improvements, as given, include the testing of all cows with tuberculin; compelling milk to be delivered in glass bottles, and the dissemination of information regarding the care and handling of milk.

MARYLAND.

Laws of 1894—chapter 53 refers to milk. The mayor and city council of Baltimore shall make regulations for the sale and provide by ordinance for the inspection of milk and food products; shall provide for and fix compensation of inspectors and analysts.

Laws of 1898—chapter 306 refers to cattle and dairies. Cows producing market milk shall be registered with the live stock sanitary board, and a certificate of health may be furnished for a herd which is kept as the law requires and has no visible sign of disease. Said board must inspect at least annually premises where cows are kept and enforce rules requiring buildings to be sanitary, well lighted and ventilated, clean, and painted or whitewashed; cows to be clean, properly fed, and watered; milk vessels to be clean, etc.

Laws of 1890—chapter 604, sections 52 to 56, refer to milk and food. Diseased or unwholesome milk must not be sold. The State board of health is given power to enforce.

Laws of 1900—supplement, article 27, page 40, refers to milk and food. The milk standard is 12.5 per cent total solids, 3.5 per cent fat. The sale of adulterated milk, milk to which any foreign substance has been added, milk from diseased cows, and milk from cows fifteen days before or five days after parturition. Skimmed milk may be sold if properly labeled. Condensed milk must be from pure milk of standard quality.

Baltimore. (Population, 508,957.)

[For comparison with other cities in Class I, see p. 26.]

G. W. Lehmann, chemist of health department.

Estimated average amount of milk used daily is 25,000 gallons, or 0.39 pint per capita; skimmed milk, 5,000 gallons; cream, 4,000 gallons. Milk is distributed from 2,530 stores and 525 wagons. In its delivery glass jars are used by about twenty different concerns, only one of which brings the milk in them from the country. Pasteurized milk is used very little and is not increasing in favor. The retail price of milk is 5 to 10 cents per quart, the producers on the farms being paid 3 to 4 cents. There are three "model dairies" near the city and their milk is sold at 8 to 10 cents per quart. Within the city limits there are 3,314 cows in 539 stables and sheds. About 1,500 dairy farms send milk into the city, some of them from a distance of 200 miles.

Ordinance No. 87, 1894, applies to milk and other food products. It requires that milk sold shall be the natural product of healthy cows, from which no cream has been removed and to which no liquid, solid, or preservative has been added; it shall contain 3 per cent fat and 12 per cent total solids, and at 60° F. have a specific gravity of at least 1.029. Skimmed milk or buttermilk may be sold if purchaser is advised of its character. The board of health enforces the ordinance and is authorized to make additional rules. Ordinance No. 130, 1894, provides for prompt confiscation of milk for violation.

The city expends annually about $2,300 in the supervision of the milk supply. Two inspectors give their entire time and one chemist part of his time to this work. The year's work in 1900 included the examination of 31,803 lots of milk, aggregating 1,166,866 gallons, of which 11,226 gallons were spilled because shown by the lactometer or general appearance to be below the legal standard. The loss of his milk is practically the only penalty suffered by the offender; no arrests are made, on account of difficulty of prosecution before police justices. During the year 900 milk samples were examined for fat content by the centrifugal test and in a few cases by gravimetric analysis. The average of the analyses of 48 miscellaneous samples of milk taken during the twelve months, and which were considered good, showed total solids 13.96 per cent; fat, 4.58 per cent. It is suggested that some dealers use preservatives and some skillfully alter their milk with the aid of the lactometer, taking care not to bring it below the required standard. About 300 samples of milk have been examined microscopically or bacteriologically for tubercle bacilli, pus cells, etc. An interesting study was made along this line: Milk from 11 dairy farms, after its arrival in the city, was found to contain from 5,160 to 383,200 bacteria per cubic centimeter, 0 to 1.4 pus cells, and no tubercle bacilli. The clarifying of milk by means of a separator was not found to reduce its bacterial content. The milk of 11 unsanitary dairies near the city limits was found in all cases to have pus cells, varying in number from 0.1 to 9.5 per cubic centimeter, and tubercle bacilli were found in the milk of 3 of these dairies. Stables within the city limits and the sanitary condition of the stock are frequently inspected by a veterinarian. In one recent year the city inspector of cow stables issued over 1,100 notices to abate nui-

sances. Two hundred and twenty of the 1,500 dairy farms sending milk into the city have been inspected under the direction of the State live-stock sanitary board.

The form to be attached to a can from which milk has been spilled is shown in Appendix IV (p. 206).

There has recently been noticeable improvement in the quality of milk and the cleanliness of dairy stables, and increased care has been taken to exclude diseased animals from dairy herds. Suggested improvements include a standard of 13 per cent total solids and 4 per cent fat, and more milk inspectors and legislation to compel all milk shippers to submit to the regulations of the local health department.

MASSACHUSETTS.

George M. Whitaker, agent of State dairy bureau, Boston.

Acts of 1901, chapters 202 and 360; 1900, chapters 300, 359, 368, and 369; and 1891, chapter 412, sections 7 to 11, provide for the protection of dairymen, sealing of glass bottles and measures, enforcement of State dairy laws by the dairy bureau, and refer to adulteration of milk and destruction of milk vessels. Public Statutes, chapter 57, sections 1 to 11, amended; and acts of 1899, chapter 169, section 1; 1896, chapter 264, sections 1 and 2; 1894, chapter 425, section 1; 1889, chapter 326, section 1; 1886, chapter 318, sections 3 and 4, amended; and 1885, chapter 352, section 8, refer to milk, milk inspectors, etc.

The dairy bureau is empowered to investigate all dairy products. The mayor and aldermen of cities shall, and the selectmen of towns may, appoint milk inspectors. (Under authority of other acts the milk inspectors of Boston, Lynn, and Somerville are appointed by the boards of health of those cities.) Persons peddling milk in cities or towns having milk inspectors must be licensed annually in May; fee, 50 cents. License number and place of business must be shown on wagons, etc., and all changes of employees must be reported. Persons selling milk from stores, etc., must be registered; fee, 50 cents. Dealers in milk or cream may register in the office of the clerk of the city or town brands for bottles, cans, etc., including the word "registered," and cause the same to be published, and the use or destruction of such vessels or mutilation or destruction of marks thereon by other parties than the owner is prohibited, and it is unlawful to put into such vessels any unclean or foul substance or matter. Inspectors may visit places where milk is sold and take samples for analysis. Duplicate samples must be given to owners when requested and report of analysis must be sent to them within ten days. It is unlawful to sell milk not of good standard quality, or adulterated milk, or milk to which water or any foreign substance has been added, or milk from cows diseased or fed upon the refuse of distilleries; and it is unlawful knowingly to feed garbage to a milch cow. The milk standard, October to March, is 9.3 per cent solids not fat, 3.7 per cent fat; April to September, 9 per cent solids not fat, 3 per cent fat. Skimmed milk must be plainly marked; its standard is 9.3 per cent solids not fat. Cans, bottles, etc., of specified capacities used for distribution of milk or cream shall be sealed as measures. Glassware, etc., used in tests shall be tested for accuracy and marked by the director of the Hatch experiment station, and once each year he shall test centrifugal machines used in such tests. Milk tests must be accurate, and persons manipulating them shall hold a certificate of competency from said director. Said director shall test by the Babcock method samples of milk or cream for farmers, creameries, factories, or milk depots, the charge being for actual cost. Convictions for selling adulterated milk must be advertised in newspapers. Condensed milk must be labeled with the name of manufacturer; if in hermetically sealed packages, brand and contents must also be shown.

The State board of health does more than the dairy bureau in the supervision of the milk supply of cities. Very few sanitary inspections are made. The dairy

bureau has no jurisdiction over local milk inspectors, but has broader power and to a limited extent cooperates with them. In most cities the chief work of the milk inspector consists of issuing licenses and keeping a record of certain statistical and other general information. In many cases their compensation is merely nominal.

In several cities and towns the State laws relating to the milk supply are published and distributed by local authorities.

Boston.[a] (Population, 560,892.)

[For comparison with other cities in Class I, see p. 26.]

Charles Harrington, M. D., inspector of milk.

Alexandre Burr, health department.

The daily receipts of milk are estimated at 82,250 gallons, or 1.17 pints per capita. In explanation of this apparently large per capita consumption, the inspector of milk states that a very large amount of milk is consumed each day at the quick-lunch places and elsewhere by the several thousand persons who live in neighboring cities and towns but spend the business hours in Boston. A single lunch room uses as high as 640 quarts daily. The milk supply is practically controlled by a few large contractors, who operate cars on the different railroads. The contractors will not sell skimmed milk. It is impracticable to estimate the amount of cream used, as a considerable part of it is shipped by express to retailers. Milk is sold in about 2,900 stores; the number of wagons employed in its delivery is not known. Licenses for the sale, etc., of milk have been issued to the number of 506. Some licensees do not operate wagons, while others may run as many as 30. It appears that milk stores from which the milk is not peddled are not required to have a license, but simply a permit. Glass bottles filled in the city are quite extensively used for delivering milk; they are used but little in its transportation. Very little pasteurized milk is on the market, and it is not increasing in favor. The retail price of milk is from 5 to 8 cents per quart (32 fluid ounces) in summer and winter, and the producers are paid about 3 cents per quart in summer and 4 cents in winter. There are about 20 well-conducted dairies in the vicinity of Boston, but, with one or two exceptions, they receive no advance in price for their product. Within the city limits there are 126 dairy herds, including 739 head. The number of dairies sending milk into the city is not known; 75 per cent of the milk supply is received by railway, the longest shipment being 140 miles.

The regulations for the sale and care of milk adopted in December, 1898, are published in circular No. 8 of the board of health. Five sections of regulations adopted in 1892 appear to be also in force. Persons selling milk must obtain a license from the board of health annually, in May; it is revocable for cause. A statement of the conditions under which each cow is kept must be filed with the inspector of milk. No milk shall be sold from cows that have not, within one year, been examined and found to be free from dangerous disease. The tuberculin test is not required. License must be posted in a conspicuous place on premises, and wagons must bear owner's name and license number. All cans and vessels used in handling milk must be cleaned or sterilized before use, nor shall they be used for any other purpose. Rooms in which milk is stored, cooled, or mixed must have tight walls and floors and be kept clean, and must have proper appliances for washing or sterilizing all dairy utensils with boiling water or steam. Such room must not be connected with water-closet, urinal, etc., nor be used for stabling animals, nor shall milk be stored in a room used for domestic or sleeping purposes. Milk in stores, restaurants, etc., must be kept in a covered box or refrigerator properly drained and cared for.

[a] The milk supply of Boston is discussed at length in Bulletin No. 20, Bureau of Animal Industry.

Every person engaged in handling milk must notify the board of health and stop the sale of milk when an infectious disease is discovered in his family or among his employees. All vessels handled by persons suffering from such diseases shall be thoroughly sterilized before being used to hold milk. Cow stables must have at least 1,000 cubic feet air space for each animal, be well lighted and ventilated, have tight roof and floors, be well drained, have a pure water supply, and be kept clean. Pastures must be clean.

A copy of the instructions sent out by an enterprising Boston milk contractor to the dairymen from whom his milk is obtained is shown in Appendix II (p. 181).

About $13,000 is expended annually in the supervision of the city milk supply. An inspector, a chemist, a clerk, and three collectors of samples give their entire time to this work. During the past year about 15,000 samples of milk were examined by lactometer and lactoscope, the Babcock test, and gravimetric analysis, all of them being tested for preservatives; no bacteriological examinations were made; all of the city herds, and "many hundreds" of the dairy farms sending milk into the city, were inspected. A detailed description of the method of procuring samples of milk for inspection is given on page 22.

The form for application to sell milk is shown in Appendix IV (p. 195).

The form for reporting conditions at dairies is shown in Appendix IV (p. 196).

The form for license to sell milk, receipt, and stub for same, are shown in Appendix IV (p. 202).

Recent marked improvement has been made in the sanitary quality of the milk supply. Suggested improvements include the education of those who use milk, as well as those who produce it. The consumer wants his milk delivered early in the morning and insists that it must be fresh. He will not deal with one who would propose to deliver as late as 10 o'clock a. m., which is about the time the milk trains arrive. So the dealer is obliged to hold the milk, perhaps in his stable, through the day and over one night, in order that it may be delivered early in the morning.

Worcester. (Population, 118,421.)

[For comparison with other cities in Class I, see p. 26.]

C. Herbert De Fosse, inspector of milk.

The milk inspector's records show that there are received in the city daily about 16,500 gallons milk, 200 gallons skimmed milk, 250 gallons cream, and 400 cans of condensed milk. It would appear from these figures that the average consumption of milk is 1.1 pints per capita. But it is somewhat less than this, for the reason that considerable milk, cream, etc., is sent from Worcester to smaller towns within a radius of 30 to 40 miles. However, it is claimed that an unusually large amount of milk is consumed in the city, much of it being employed in cooking; bread made with milk is used to a large extent. It is estimated that the residents of the city pay annually for milk $1,095,000. Milk is distributed from 400 stores and 350 wagons. About 85 per cent of the supply is delivered in glass bottles, and these are filled at the farms. Only about one two-hundredth part of the milk is pasteurized, and this treatment does not seem to be increasing in favor. The retail price of milk is 5½ cents per quart, both summer and winter, its producers receiving 3¾ cents per quart throughout the year. Twenty-five of the dairies which are conducted in the most satisfactory manner sell their product at 7 cents per quart in summer and 8 cents in winter. Within the city limits there are 340 dairy herds, including 4,036 head. Five hundred and sixty-eight dairy farms send milk into the city; about 1 per cent is received by railway, the longest shipment being 25 miles.

The city authorities appropriate $1,000 annually for the supervision of the milk supply. Three officers give a part of their time each day to this work. During the past year 1,400 samples of milk were examined, 200 general bacteriological examinations were made, and 316 dairy herds within the city limits were inspected.

The form for recording data regarding milk samples is shown in Appendix IV (p. 204.)

The form for reporting analyses of milk samples is shown in Appendix IV (p. 206).

Previous to April, 1899, little was done to govern the supply of milk in this city. Since that date facilities for examining milk samples have been provided by the equipment of a new laboratory.

The recent introduction of a large number of cows giving rich milk has caused a marked improvement in the quality of the supply. An ordinance is needed to regulate the sanitary condition of places where milk is kept.

Fall River. (Population, 104,863.)

[For comparison with other cities in Class I, see p. 26.]

Thomas F. Wiseman, secretary of the board of health.

The daily consumption of milk is estimated at 6,000 gallons, or about 0.46 pint per capita. The estimated quantities of skimmed milk and cream used daily are 4 and 50 gallons, respectively. Milk is distributed from 327 stores and 320 wagons. About 10 per cent of the milk is delivered in glass bottles, and the portion thus handled is increasing. The bottles are filled almost exclusively at the farms. Little, if any, milk is pasteurized. The retail price of milk is 5 to 6 cents per quart in summer and 6 to 7 cents in winter. The producers on the farms realize 3½ to 4½ cents per quart in summer and 4 to 5½ cents in winter. The product of five well-conducted dairies is sold for 7 cents per quart throughout the year. Within the city limits there are 105 herds of milch cows, including 350 head. Two hundred and forty dairy farms send milk into the city. All these are within a radius of 10 miles, and the milk is brought in by teams.

An ordinance adopted June, 1899, and milk regulation No. 71 refer to the milk supply. A license to sell milk in a store or from a wagon must be obtained from the board of health, and all dairy premises, vessels, and vehicles must be kept in a sanitary condition satisfactory to said board. License must be posted in stores and carried in delivery wagons, and wagons must bear owner's name and wagon and license numbers. Milk adulterated by watering, skimming, or by the addition of any foreign substance, milk from diseased cows or cows fed on distillery waste or other fermented food, milk from cows within fifteen days before or five days after calving, or milk from cows kept in a crowded or unhealthy condition is prohibited, and may be seized and destroyed. The milk standard is 12 per cent solids, 3 per cent fat. Persons selling skimmed milk must obtain a special license from the board of health, and delivery wagons and vessels must be plainly marked "Skimmed milk," etc. Milk shall not be kept, nor bottles washed, in any room used for sleeping or any domestic purposes or in a room opening into the same, nor shall milk be stored in a stable, and a room separate from the stable and water-closet shall be provided on dairy farms for straining and cooling milk, the same to have tight floors and walls. Cows must be examined at least once a year for tuberculosis and other contagious diseases in a manner approved by the board of health. All dairies shall be inspected at least every June and December, and written report of their condition filed with the city clerk for public examination. Walls of cow stables must be cleaned and whitewashed at least once every six months. Milk in stores must be kept in a refrigerator or other tight receptacle separate from any food or contaminating product, and iced in warm weather. Milk in wagons shall be protected from dust, and on the streets it shall never be transferred from one vessel to another except when delivered to the consumer. Milk shall not be sold in bottles unless they are first washed with hot water cleaning solution and then with clean hot water; they must not be filled except at the dairy or creamery, or in a room free from dust. Vessels handled by persons suffering from a contagious disease must be sterilized before

being used to hold milk. No attendant suffering from or suspected of a contagious disease is allowed to care for cows or handle milk. Every person engaged in handling milk must notify the board of health and stop the sale of milk when an infectious disease is discovered in his family or among his employees.

The section referring to skimmed milk is shown in Appendix I (p. 179).

About $1,250 is expended annually in the supervision of the milk supply. One milk inspector gives his entire time to this work. During the year 257 samples were examined by the Babcock test, 7 being found below standard; no bacteriological examinations were made. All the dairies within the city and all of the dairies and farms sending milk to the city were inspected.

Since the appointment of a milk inspector there has been much improvement in the sanitary condition of dairies, milk utensils, etc. It is believed that to a certain extent the production of market milk should be under State authority. Frequent bacteriological examinations of the milk supply should be made.

The form for recording inspection of stores, etc., is shown in Appendix IV (p. 207).

The form for recording inspection of wagons, etc., is shown in Appendix IV (p. 208).

Lowell. (Population, 94,969.)

[For comparison with other cities in Class II, see p. 30.]

Thomas O. Allen, inspector of milk and vinegar.

The daily consumption of milk is estimated as 7,700 gallons, or 0.65 pint per capita, besides 200 gallons of skimmed milk and 50 gallons of cream. Milk is sold from about 350 stores and 156 wagons. Glass bottles are used in the delivery of about one-fourth of the total supply, and are filled both in the city and at the dairy farms. Only about 3 per cent of the mik is pasteurized, and there is no increase in the practice. The retail price of milk is 5 cents per quart in summer and 6 cents in winter, the producers receiving 2.7 cents in summer and 3 cents in winter. The product of one "model dairy" near the city is sold for 7 cents per quart throughout the year. There are only about 100 cows within the city limits, and no data are available as to the number of dairy farms sending milk into the city. About 300 gallons is shipped into the city by railway, the longest shipment being 20 miles.

State laws regulate the milk supply.

The supervision of the milk and vinegar cost the city last year $2,329.97. Two officials—one inspector, who is also city analyst, and one collector of samples—give their entire time to this work. During the past year 2,972 samples of milk were examined by the Babcock test and by gravimetric analysis; only a few bacteriological examinations were made.

The averages of total solids in samples of milk collected from wagons and stores, in different months of the year, are as follows:

	From wagons.	From stores.		From wagons.	From stores.
	Per cent.	*Per cent.*		*Per cent.*	*Per cent.*
January	12.80	12.16	July	12.70	11.50
February	12.92	12.41	August	12.72	12.06
March	13.16	12.98	September	13.00	12.83
April	13.11	13.21	October	13.07	12.47
May	12.82	13.20	November	13.03	11.94
June	12.92	12.05	December	13.00	12.77

It is stated that a law is needed to regulate the sanitary condition of dairy barns, lots, pastures, etc., and that it would be well to have a standard of cleanliness for dairies, those not coming up to it to be excluded from the privilege of selling milk in the city.

Cambridge. (Population, 91,886.)

[For comparison with other cities in Class II, see p. 30.]

Philip P. Sharples, inspector of milk.

The daily consumption of milk is estimated as 9,074 gallons, or 0.79 pint per capita. In addition to what is used by ice-cream manufacturers and bakers, 202 gallons of skimmed milk and 116 gallons of cream are used in family trade. There are sold, daily, 4,324 gallons of milk from 410 stores, 4,639 gallons by 156 milkmen, and 111 gallons from "private cows." Three-fourths of the milk used in family trade is delivered in glass bottles, the greater part of them being filled in the city. Little or no milk is pasteurized; one concern tried it, but is now out of business. The retail price of milk is 4 to 8 cents per quart in summer and 5 to 9 cents in winter, the producers receiving 3¼ cents in summer and 3½ cents in winter. The milk of a few well-conducted dairies near the city is sold for 8 cents per quart in summer and 9 cents in winter. Within the city limits there are 76 herds of milch cows, including 234 head. Five hundred or more dairy farms send milk into the city. The city herds produce, daily, 476 gallons of milk; wagons haul to the city 3,770 gallons, and railway trains bring 4,828 gallons. The longest shipment is 100 miles.

The city has no milk ordinance, the milk supply being regulated by State laws.

One thousand five hundred dollars is expended annually in the supervision of the milk supply. Two officials—an inspector and his deputy—give one-half of their time to this work. During the past year 3,367 samples of milk were examined by the Babcock test; suspected samples were tested for coloring and preservatives, and all the city herds were inspected.

The form used when applying for milk license is shown in Appendix IV (p. 188).

Recent improvement in the quality of the milk supply is said to be due to the fact that it is now largely in the control of concerns that pay strict attention to the character of the milk they handle. It is recommended that the license fee for stores be raised to $50.

Lynn. (Population, 68,513.)

[For comparison with other cities in Class II, see p. 30.

William E. Welts, inspector of milk.

The daily consumption of milk is estimated as 6,000 gallons, or 0.70 pint per capita, besides 600 gallons of skimmed milk and 125 gallons of cream. Milk is sold from 350 stores and 75 wagons. Glass bottles are used to a limited extent in the delivery of milk, these being filled both in the city and at the producing farms. Only a very small quantity of milk is pasteurized and the practice is decreasing. The retail price of milk is 4 to 7 cents per quart, both summer and winter, the producers receiving 2 to 3½ cents per quart throughout the year. A few especially well-conducted dairies near the city sell their product for 7 cents per quart the year round. Within the city limits there are 60 herds, including 350 cows, and milk is sent into the city from about 800 dairy farms. Two-thirds of the entire milk supply is shipped by railway, the longest shipment being about 300 miles.

Regulations adopted in April, 1899, supplement the State laws referring to the milk supply. Cows which produce milk for the city must have been examined (within one year) and found free from dangerous disease. Rooms where milk is handled must be properly constructed and located; all dairy utensils must be kept clean and, when exposed where contagious disease exists, must be thoroughly sterilized. Milk from places where there is any contagious disease is prohibited.

The city expends $2,500 annually in the supervision of its milk supply. Two officials—an inspector and a collector of samples—give their entire time to this work. The number of milk samples examined during the past year is not reported; all the

herds in the city and all the dairy farms within the State sending milk to the city have been inspected.

Recently the quality of the milk supply has improved, due to the enforcement of the milk regulations. It is recommended that tuberculin tests be made of cows outside the State producing milk for the city.

Lawrence. (Population, 62,559.)

[For comparison with other cities in Class II, see p. 30.]

Michael A. Scanlon, inspector of milk.

The daily consumption of milk is estimated as 6,000 gallons, or 0.76 pint per capita, besides 500 gallons of skimmed milk and 200 gallons of cream. Milk is sold from 700 stores and 200 wagons. Glass bottles are used quite extensively in the delivery of milk. The increase in their use will be checked by the destruction of some bottles under an act of the State legislature requiring all bottles to be sealed by the sealer of weights and measures. The bottles are filled mostly at the producing farms. Little or no milk is pasteurized. The retail price of milk is about 6 cents per quart throughout the year. The producers realize 2½ to 3 cents per quart in summer and 3½ to 4 cents in winter. Within the city limits there are 8 dairy herds, including 130 cows. The longest shipment of milk from the country is 12 miles.

State laws regulate the city milk supply.

Only about $350 is expended annually in the supervision of the city milk supply. The inspector (salary $150 per year) gives one hour daily to this work, occasionally going out to collect samples. During the past year 179 samples were examined by the Babcock test, and all of the city herds were inspected. When milk samples are found by the Babcock test to be below the standard, they are submitted to chemical analysis, for which the city pays $2 per sample.

Recently a more even quality of milk has been supplied, owing to mixing the milk of numerous herds of cows, and its quality has improved because of more sanitary conditions at dairies. It is stated that the license fee should be raised from 50 cents to $25 or more, and closer attention should be given to producing dairies.

New Bedford. (Population, 62,442.)

[For comparison with other cities in Class II, see p. 30.]

Daniel C. Ashley, D. V. S., inspector of milk, provisions, and animals.

The daily consumption of milk is estimated as 7,000 gallons, or 0.90 pint per capita. Milk is sold from 201 stores and 170 wagons. A very small part of the milk is delivered in glass bottles, and these are filled at the producing farms. No milk is pasteurized. The retail price of milk is about 6 cents per quart throughout the year, producers receiving 3 to 3½ cents in summer and 3½ to 4 cents in winter. There are no "model dairies" near the city. Within the city limits there are 700 milch cows, kept 1 to 20 in a place. Milk is received from many of the adjacent towns. Only a small portion of the supply comes in by railway, the longest shipment being 20 miles.

State laws regulate the milk supply.

About $1,500 is expended annually for the inspection of milk, provisions, and animals. Two officials—an inspector and one assistant—give their entire time to this work. During the past year 900 samples of milk were examined by lactometer, lactoscope, etc.; no bacteriological examinations were made; all the city herds were inspected.

The inspector states that the most needed improvements are a more thorough inspection of milch cows with the aid of turberculin, and the enforcement of a requirement that dairy utensils be scalded after use.

Springfield. (Population, 62,059.)

[For comparison with other cities in Class II, see p. 30.]

James Kimball, inspector.

The daily consumption of milk is estimated as 4,750 gallons, or 0.61 pint per capita. Milk is sold from 103 stores and 133 wagons. About 1,000 quarts of milk is delivered in glass bottles, which are filled in the city. No milk is pasteurized. The retail price[a] of milk is 6 cents per quart, both summer and winter, except bottled milk, which sells for 7 cents per quart. The producers receive 3 cents per quart in summer and 3½ cents in winter. There are no "model dairies" in or near the city. Within the city limits there are 20 herds of milch cows, including 130 head, besides about 100 cows kept in private stalls, 1 or 2 in a place. Milk is sent into the city from 420 dairy farms. All the milk is brought in by teams, the longest haul being 14 miles.

A cooperative milk association controls a large part of the trade in Springfield. This association was organized in 1884. According to the fifteenth annual report (1899), the receipts of milk during that year were 2,911,218 quarts, which was 38,000 quarts less than the receipts of the previous year. There was paid to the farmers $68,751.29, which was $1,373.08 more than in the previous year. The report showed 150 patrons, 86 of whom were stockholders.

There is no city milk ordinance.

The city expends annually $100 in the supervision of its milk supply. During the past year a number of samples were examined by the lactometer and the Babcock test.

Recent improvement has been made in the milk supply, by an organized effort on the part of dealers requiring the producers to adopt better sanitary methods in handling milk. There is need for a thorough inspection of all premises where milk is handled.

Somerville. (Population, 61,643.)

[For comparison with other cities in Class II, see p. 30.]

J. E. Richardson, inspector of milk and vinegar.

The quantity of milk sold daily is reported as 7,640 gallons, or an average of 0.99 pint per capita, besides 400 gallons of skimmed milk and 500 gallons of cream. In explanation of the apparently large consumption of milk it is stated that a part of the milk reported is probably sold in adjacent towns. Milk is sold from 300 stores and 185 wagons. In addition to the above, there were 5 cream teams, 1 condensed milk, and 1 modified-milk team licensed. Glass bottles, filled in the city, are used in the delivery of about one-half of the milk supply. Only a limited amount of milk is pasteurized, with no increase in the practice. The retail price of milk is 6 cents per quart in summer and 7 cents in winter, the producers receiving 3 cents in summer and 4 cents in winter. There are no "model dairies" near the city. Within the the city limits there are 2 herds, including 62 milch cows, besides 222 cows kept 1 or

[a] The retail prices established by the local milk dealers' association are as follows:

	Cents per quart
Pasteurized and sterilized milk	8
Bottled milk	7
Can delivery, private families	6
Boarding houses, hotels, etc:	
Less than 5 quarts daily	6
From 5 to 10 quarts daily	5
Ten quarts or more daily	4½
Stores	4½

2 in a place. There is no record of the number of dairy farms sending milk into the city. Seven-eighths of the total supply is received by railway, the longest shipment being 175 miles.

The milk supply is regulated by State laws.

About $500 is expended annually in the supervision of milk, one inspector giving a part of his time to this work. During the past year 575 samples of milk were examined by the Babcock test and by gravimetric analysis; no bacteriological examinations were made; 19 milk cases were prosecuted.

Holyoke. (Population, 45,712.)

[For comparison with other cities in Class III, see p. 36.]

James K. Morrill, inspector of milk and vinegar.

The daily consumption of milk is estimated as 4,373 gallons, or 0.77 pint per capita; also 488 gallons of skimmed milk and 63 gallons of cream. Milk is sold from 172 stores and 136 wagons, and about 25 per cent is delivered in glass bottles, which are filled mostly at the farms. Very little milk is pasteurized, and the practice is not increasing. Milk is retailed at 5 cents per quart in summer and 6 cents in winter, the producer receiving 3¼ cents and 3¾ cents, respectively. The milk from a few specially well-conducted dairies near the city is sold for 7 cents per quart in summer and 8 cents in winter. Within the city limits there are 78 herds, including 858 cows, and milk is sent in from 2,750 cows on about 300 farms. Very little milk is received by railway, the longest shipment being 16 miles.

The city has no milk ordinance, but prints State laws referring to milk.

The city expends annually about $500 in the supervision of its milk supply, two officials giving nearly half their time to this work. During the past year 260 samples of milk were examined by the Babcock test; no bacteriological examinations were made; all the city herds were inspected, and there were 5 prosecutions for violations, and 14 warnings. The prosecutions were: One for selling skimmed milk from a can not properly marked, 1 for peddling milk without license, 3 for selling milk from stores without license.

The form for warning against the sale of adulterated milk is shown in Appendix IV (p. 209).

It is stated that there should be some limitation to sale of milk in markets, candy stores, etc., and that glass bottles should be more generally used.

Brockton. (Population, 40,063.)

[For comparison with other cities in Class III, see p. 36.]

Benjamin Thatcher, inspector of milk.

The daily consumption of milk is estimated as 3,200 gallons, or 0.64 pint per capita, besides 50 gallons of skimmed milk and 40 gallons of cream. Milk is sold from 150 stores and 150 wagons. About one-half the milk is supplied in glass bottles filled at the farms, and a large percentage of it is pasteurized. The retail price of milk is 6 cents per quart throughout the year. There is one "model dairy" near the city, but its product is not sold for an extra price. Within the city limits there are 41 herds, including 584 cows. Milk is supplied from 20 dairy farms, the most distant one being 16 miles. No milk is received by railway.

The city has no milk ordinance or regulation.

During the past year $100 was expended for milk-inspection work; 25 samples of milk were examined; all the city herds and all the dairy farms were inspected.

Haverhill. (Population, 37,175.)

[For comparison with other cities in Class III, see p. 36.]

Grantley W. Bickell, inspector of milk.

The daily consumption of milk is estimated as 3,290 gallons, or 0.71 pint per capita. Milk is sold from 120 stores and 100 wagons. Glass bottles, filled at the farms, are used very largely in the delivery of milk. No milk is pasteurized. The retail price is 6 cents per quart throughout the year, the producers receiving 3 cents and 3½ cents, respectively, in summer and winter. The milk from a few dairies conducted in a very satisfactory manner is sold at the regular price. Within the city limits there are 120 herds, including about 1,000 cows, and milk is sent in from 125 dairy farms, the most distant being 10 miles.

A city ordinance requires four dairy inspections per year.

The city expends annually about $150 in the supervision of its milk supply. No one official gives his entire time to the work. During the past year 275 samples of milk were examined by lactometer and Babcock test; no bacteriological examinations were made; all the city herds and 39 of the 125 dairy farms were inspected.

The form to accompany application for milk license is shown in Appendix IV (p. 191).

Improvement has recently been shown in the grade of cows, sanitary conditions of the buildings, and the care of utensils. The importance of having attendants free from disease is emphasized.

Salem. (Population, 35,956.)

[For comparison with other cities in Class III, see page 36.]

R. L. Newcomb, clerk of the board of health.

The daily consumption of milk is estimated as 4,200 gallons, or 0.93 pint per capita, besides 33 gallons of cream. Milk is sold from 80 stores and 61 licensed wagons. One-third of the total quantity delivered is supplied in glass bottles, filled either at the farms or in the city. About 20 gallons of milk is pasteurized daily, and is sold for 7 cents per quart. The demand for milk so treated is increasing. The retail price of milk is 6 to 7 cents per quart in summer and 6 to 8 cents in winter, producers receiving 3½ to 4 cents throughout the year. The milk from a few especially well-conducted dairies near the city is sold for 7 to 8 cents per quart. Within the city limits there are 6 herds, including about 185 cows, and milk is sent in from 20 dairy farms, the most distant being 12 miles.

State officials supervise the milk supply.

Chelsea. (Population, 34,072.)

[For comparison with other cities in Class III, see p. 36.]

George F. Marsh, inspector of milk.

The daily consumption of milk is estimated as 3,800 gallons, or 0.89 pint per capita, besides 100 gallons of skimmed milk and 40 gallons of cream. Milk is sold from 179 stores and 46 wagons. Glass bottles are used almost entirely for retail delivery, being filled in the city. Milk is pasteurized only for special orders, and the practice is not increasing. The retail price of milk is 4 to 7 cents per quart in summer, and 5 to 8 cents in winter. There are no "model dairies" near the city. Within the city limits there are 15 herds, including 140 cows. Ninety per cent of the milk is furnished by Boston contractors.

About $225 is expended by the city for milk-inspection work. During the past year 1,058 samples of milk were examined by the lactoscope; no bacteriological examinations were made; all the city herds were inspected.

An inspector is needed who is well equipped for the work and able to give it sufficient time.

Malden. (Population, 33,664.)

[For comparison with other cities in Class III, see p. 36.]

Henry M. Hartshorn, inspector of milk and vinegar.

The daily consumption of milk is estimated as 3,000 gallons, or 0.71 pint per capita, besides skimmed milk and cream in variable quantities. Milk is sold from 95 stores and 45 wagons. Only a few milkmen use glass bottles in the delivery of milk, and these are filled in the city. Little or no milk is pasteurized. The retail price of milk is 6 cents per quart in summer and 7 cents in winter, producers receiving 3½ and 4 cents, respectively. There are no "model dairies" near the city. Within the city limits there are 25 herds, including 183 cows. About half of the milk supply is received by railway, the longest shipment being 75 miles; this latter portion is believed to be of poorer quality than the milk produced near by.

The revised ordinances of 1894, chapter XXX, supplement the State laws in regard to milk. License fee for the sale of milk is 50 cents. Name and place of business of every person convicted of selling adulterated milk must be printed in two newspapers in the city or county, as well as in the report of the milk inspector.

The ordinance section regarding publication of names of violators is given in Appendix I (p. 180).

The city expends annually about $300 in the supervision of its milk supply, one official given a part of his time to this work. During the past year 475 samples of milk were analyzed gravimetrically; no bacteriological examinations were made; nearly all the city herds were inspected.

The examination of samples for milkmen and consumers is believed to have a beneficial and improving effect.

Newton. (Population, 33,587.)

[For comparison with other cities in Class III, see p. 36.]

Arthur Hudson, inspector of milk.

The daily consumption of milk is estimated as 5,275 gallons, or 1.25 pints per capita, besides 32 gallons of cream. Milk is sold from 140 stores and 130 wagons. Three-fourths of the milk is delivered in glass bottles, filled both in the city and at the farms. Very little milk is pasteurized, but the practice is increasing. The retail price of milk is 7 to 8 cents per quart throughout the year, producers receiving 3½ to 4 cents. The milk from one "model dairy" near the city is sold regularly for 8 cents per quart. Within the city limits there are 41 herds, of 7 or more animals each, including 1,170 cows, besides those kept by private families. Sixty-three dairy farms send milk into the city. Only 21 gallons of milk is received daily by railway, the longest shipment being 50 miles.

During the past year $601.39 was expended in the supervision of the city milk supply, one inspector giving about half of his time to this work. Samples to the number of 1,562 were examined by lactometer, doubtful samples by gravimetric analysis; bacteriological examinations were made for tubercle, typhoid, and lactis viscosis bacilli; all the city herds were inspected.

The form for notification that license to sell milk must be secured is shown in Appendix IV (p. 200).

There has been a recent improvement in the sanitary conditions at dairies and in the methods of handling milk. It is urged that printed instructions regarding the feeding of animals and the cooling and bottling of milk be distributed among milk producers.

Fitchburg. (Population, 31,531.)

[For comparison with other cities in Class III, see p. 36.

John F. Bresnahan, inspector of milk.

The daily consumption of milk is estimated as 4,541 gallons, or 1.15 pints per capita, besides 45 gallons of cream. Milk is sold from 99 stores and 126 wagons. Glass bottles, filled at the farms, are used quite extensively in the delivery of milk. No milk is pasteurized. The retail price is 6 cents per quart throughout the year, producers receiving 2⅜ cents in summer and 2½ cents in winter. The milk from a few well-conducted dairies near the city is sold at the regular price. Within the city limits there are 34 herds, including 404 cows, and milk is sent in from 1,152 cows on 58 dairy farms within 12 miles of the city.

Board of health regulations, May and June, 1897, supplement the State laws in regard to milk. A special license is required for the sale of skimmed milk. Milk bottles must be filled in properly constructed rooms and be thoroughly cleaned before using. Milk should be kept at a temperature below 50° F. In selling milk, the contents of a can should be mixed before measuring out the desired quantity. Cow stables must be properly constructed and located, and be kept clean. Cows must be groomed at least three times a week when kept in stables. Adulterated, etc., milk is prohibited, and may be seized and destroyed. The milk standard is 12 per cent solids, 3 per cent fat.

The city expends annually $300 (?) in the supervision of its milk supply as the salary of the milk inspector. During the past year 25 samples of milk were examined by the lactometer; 4 bacteriological examinations were made for bacilli of typhoid fever and diphtheria. All of the city herds but none of the dairy farms were inspected.

Taunton. (Population, 31,036.)

[For comparison with other cities in Class III, see p. 36.]

F. M. Scudder, inspector of milk.

The daily consumption of milk is estimated as 2,532 gallons, or 0.65 pint per capita. Milk is sold from 26 stores and 135 wagons. It is retailed at 6 cents per quart throughout the year. There are no "model dairies" near the city. Within the city limits there are 77 herds, including 810 cows. The most distant dairy farm supplying milk is 9 miles from the city. No milk is received by railway.

About $50 is expended annually by the city in the supervision of its milk supply, one inspector giving a part of his time to this work. During the past year 7 samples of milk were examined by the lactometer; no bacteriological examinations were made; all the city herds and nearly all of the dairy farms were inspected.

Gloucester. (Population, 26,121.)

[For comparison with other cities in Class III, see p. 36.]

Fred Corliss, inspector of animals, provisions, milk, and vinegar.

The daily consumption of milk is estimated as 2,300 gallons, or 0.70 pint per capita, besides 125 gallons of cream. No skimmed milk is sold. Milk is sold from 124 stores and 88 wagons. Glass bottles, filled at the farms, are used in the delivery of about 12 per cent of the milk supply. Very little milk is pasteurized and the practice is not increasing. Milk is retailed from stores at 6 cents per quart and from wagons at 7 cents throughout the year, the producer receiving 3½ cents. Within the city limits there are about 700 cows and 50 herds. The most distant dairy farm supplying milk is 16 miles from the city.

The city expends annually $150 in the supervision of its milk supply, the inspector giving a part of his time to this work. During the past year all of the city cows were inspected; no samples of milk were examined for composition.

North Adams. (Population, 24,200.)

[For comparison with other cities in Class IV, see p. 40.]

Albert G. Nichols, inspector of milk.

The daily consumption of milk is estimated as 2,000 gallons, or 0.66 pint per capita, besides 75 gallons of skimmed milk and 25 gallons of cream. Milk is sold from 10 stores and 50 wagons. About one-fourth of it is delivered in glass bottles filled at the farms; little or none is pasteurized. The retail price is 5 cents per quart in summer and 6 cents in winter, producers receiving 3 cents throughout the year. There are a few dairies conducted better than others, but they do not receive an advance in price for their product. Within the city limits there are 27 herds, including 377 cows, and milk is brought in wagons from 75 dairy farms, the longest haul being 9 miles.

An ordinance adopted in February, 1900, refers to milk. It requires that dairies, etc., be inspected in June and December, and premises and apparatus be kept clean; that cows be free from tuberculosis, and stables be whitewashed; that milk rooms be properly located and constructed; and that persons handling milk be free from contagious disease.

One hundred dollars is expended annually in the supervision of the milk supply, but this does not include a portion of the salary of the inspector of animals. During the past year about 300 samples of milk were examined by the Babcock test; no bacteriological examinations were made; all the city herds and all the dairy farms were inspected.

Recent improvement in the city milk supply is due to an increased use of bottles. Further improvement would result from the pasteurization of milk and the sterilization of utensils.

Woburn. (Population, 14,254.)

[For comparison with other cities in Class IV, see page 40.]

Gorden Parker, inspector of milk and vinegar.

The daily consumption of milk is estimated as 1,032 gallons, or an average of 0.58 pint per capita. Milk is sold from 16 stores and 30 wagons. Glass bottles are in general use in the delivery of milk and are filled in the city and at the farms. Little or no milk is pasteurized. The retail price is 6 cents per quart throughout the year, producers receiving 3⅛ cents and 3¾ cents in summer and winter, respectively. There are no "model dairies" near the city. The longest distance milk is supplied to the city is 5 miles.

One hundred dollars is expended annually in the supervision of the milk supply. During the past year 25 samples of milk were examined by lactometer and gravimetric analysis. Cattle are inspected by the local inspector of cattle and provisions under the direction of the State board of health.

Improvement of the milk supply might be brought about by frequent inspection of herds and barns, and by educating consumers as to what good milk is, so that they will demand it.

Melrose. (Population, 12,962.)

[For comparison with other cities in Class IV, see p. 40.]

William S. Briry, inspector of milk and vinegar.

The daily consumption of milk is estimated as 800 gallons, or 0.49 pint per capita, besides 25 gallons of skimmed milk and 20 gallons of cream. Milk is sold from 49 stores and 69 wagons. Nearly all milkmen deliver milk in glass bottles filled in the city. Some cream is pasteurized, and the practice is increasing. The retail price of milk is 5 to 7 cents per quart throughout the year, producers receiving 4 cents. Six

dairies, better conducted than others, receive 7 cents per quart for their product. Within the city limits there are 40 herds, including 150 cows, and milk is sent in from 25 dairy farms. About 5 per cent is received by railway, the longest shipment being 10 miles.

The city prints State laws relating to the inspection and sale of milk.

One hundred dollars is expended annually in the supervision of the milk supply, one official giving a part of his time to this work. During the past year 36 samples of milk were examined by lactometer and gravimetric analysis; no bacteriological examinations were made.

Wakefield. (Population, 9,290.)

[For comparison with other cities in Class IV, see p. 40.]

Josiah S. Bonney, inspector of milk.

The daily consumption of milk is estimated as 800 gallons, or an average of 0.68 pint per capita. Milk is sold from 93 stores and 54 wagons. A large amount of milk is delivered in glass bottles filled at the farms; little if any is pasteurized. The retail price is 6 cents per quart throughout the year, producers receiving 3½ cents in summer and 4 cents in winter. A few well-conducted dairies receive 7 cents per quart for their product. Within the city limits there are 83 herds, including 343 cows. About 12 per cent of the milk is received by railway, the longest shipment being 35 miles.

There is allowed annually the sum of $150 as salaries of milk inspector and collector. During the past year 154 samples of milk were examined by the Babcock test and gravimetric analysis; no bacteriological examinations were made; all the city herds were inspected; $150 was collected as fines, and $40 as license fees.

The inspector believes that better sanitary conditions should obtain at dairies, and that all the milk should be pasteurized.

North Attleboro. (Population, 7,253.)

[For comparison with other cities in Class IV, see p. 40.]

W. Henry Kling, inspector of milk, provisions, and cattle.

The daily consumption of milk is estimated as 885 gallons, or 0.98 pint per capita. Milk is sold from 6 stores and 34 wagons. Four dealers deliver milk in glass bottles filled at the farms. No milk is pasteurized. The retail price is 6 cents per quart throughout the year, producers receiving 3 to 3½ cents in summer and 4 cents in winter. There are no "model dairies" near the city. Within the city limits there are 24 herds, including 275 cows, and milk is brought in wagons from 8 dairy farms, the longest haul being 4 miles.

About $200 is expended annually in the supervision of the milk supply, one official giving a part of his time to this work. During the past year 150 samples of milk were examined by the Babcock test; no bacteriological examinations were made; 535 cows were inspected, and 3 condemned for tuberculosis.

A copy of the form used for placing a cow or cows in quarantine when suspected of having tuberculosis is shown in Appendix IV (p. 199).

Recent improvement in the milk supply is due to cleaner barns and cows and to more care in handling milk. It is recommended that employees wear special clothes while milking; that milk be removed from the stable immediately after milking; that cows be fed pure feeds and curried daily, and that udders be washed before milking.

MICHIGAN.

W. B. Snow, dairy and food commissioner, Lansing.

Public acts of 1893—No. 211, amended, provides that the dairy and food commissioner shall inquire into the quality of dairy products sold in the State, and gives him

authority to take samples for analysis. Prosecuting attorneys shall assist in enforcing the food laws. Monthly bulletins shall be issued showing results of inspections.

Public acts of 1887, No. 246, amended; 1899, No. 106, and 1873, No. 26, refer to milk and milk inspectors. The police commissioners of Detroit appoint a milk inspector, with rank of captain, sergeant, or roundsman. He is given authority and required to make inspections in Detroit and Wayne County. Common councils of cities and boards of trustees or councils of villages may appoint milk inspectors with similar powers. It is unlawful to sell unwholesome, adulterated, or impure milk; or swill milk; or colostrum; or milk from cows kept on garbage, swill, or any fermenting or deleterious substance; or milk from cows kept in connection with a family where there is an infectious disease; or milk, skimmed milk, buttermilk, or cream to which water, preservatives, or any foreign substance has been added; or knowingly to sell milk from diseased cows or cows fed on the refuse of a distillery or a brewery. The milk standard is 12.5 per cent milk solids, 3 per cent fat, and a specific gravity at 60° F. between 1.029 and 1.033. Skimmed milk must be plainly marked and have a specific gravity between 1.032 and 1.037.

Public acts of 1895—No. 193 forbids the sale of adulterated food, which term is defined at length.

The dairy and food commissioner issues a monthly report showing in considerable detail the amount and character of the work performed. Each report contains brief statements regarding the conditions of dairies visited during the month in the vicinity of cities and towns throughout the State. The character of the statements concerning dairies can best be shown by quoting one, which refers to an apparently well-managed place, and another referring to one in much need of improvement; they are as follows:

(*a*) Condition of cows, very good and clean; feed, corn fodder, hay, and ground corn and oats; stables, very neat and clean and whitewashed; yard, clean and dry; ventilation, good; water, well; milk room, neat and clean, has cement floor; uses an aerator.

(*b*) Condition of cows, good; feed, fodder, corn, and chops; stables, dirty and dark; yard, muddy and filthy; ventilation, none; water, well.

This system of inspection is said to have had a very beneficial effect upon the milk supply of cities and villages. During the past year 447 dairies supplying milk to 48 cities and villages were reported upon, in the different months, as follows:

Month of inspection.	Cities and villages.	No. of inspections.	Month of inspection.	Cities and villages.	No. of inspections.
January	Lansing	40	September	Flint	16
February	Ypsilanti	8		Holly	2
	Battle Creek	45		Mount Pleasant	1
March	Jackson	57	October	St. Clair	3
April	Adrian	16		Marine City	5
	Hudson	3		Algonac	1
	Waldron	1		Mount Clemens	9
	Hillsdale	6	November	Reading	2
	Jonesville	6		Hillsdale	3
May	Eaton Rapids	4		Adrian	8
	Charlotte	5	November	Union City	2
	Wayne	5		Three Rivers	4
	Northville	2		Cassapolis	2
	Albion	6		Kalamazoo	6
	Marshall	6		Allegan	2
	Grass Lake	1		Benton Harbor	4
	Chelsea	5		St. Joseph	7
June	Saginaw	68		Monroe	3

Month of inspection.	Cities and villages.	No. of inspections.	Month of inspection.	Cities and villages.	No. of inspections.
November.....	Summerfield Township	2	December	Homer	1
	Niles	4		Albion	3
December	Port Huron.....	25		Jonesville	2
	Pontiac.....	10		Manistee	1
	Lapeer	2		Big Rapids	4
	Wyandotte	12		Eaton Rapids.....	2
	Alma	4		Total inspections in 48 cities and villages.....	167
	Ithaca	2			
	Hart.....	1			
	Frankfort	1			
	Cadillac	6			

The department has waged a vigorous campaign against the use of preservatives, and reports 49 prosecutions.

Detroit. (Population, 285,704.)

[For comparison with other cities in Class I, see p. 26.]

M. B. Fauykner, milk inspector.

C. L. Stewart, M. D., milk inspector.

The daily consumption of milk is estimated as 15,000 gallons, or 0.42 pint per capita. While the daily receipts of milk are 25,000 gallons, a considerable portion of this is delivered to suburban places and used in the manufacture of ice cream, butter, and cheese. It is also estimated that 2,000 gallons of skimmed milk and 700 gallons of cream are consumed daily. Milk is sold from 700 stores and 230 wagons. Glass bottles are used in the delivery of about half the total supply. Pasteurized milk is used only to a small extent, but its use is increasing. The retail price of milk is 5 cents per quart in summer and 6 cents in winter, the producers receiving 2 cents in summer and 2½ cents in winter. Three "model dairies" near the city sell their product for 7 cents per quart in summer and 8 cents in winter. Within the city limits there are 50 dairy herds, including 250 head. About 500 dairy farms send milk into the city.

A city ordinance of twelve sections, adopted and amended in 1897, regulates the city milk supply. Any person selling milk must have a license for each establishment or vehicle. Every person delivering milk by hand "in quantities less than 1 gallon to each customer" shall wear upon his vest a small shield bearing the number of his license. Licenses are issued annually by the mayor and cost $1 each. Adulterated milk, milk from cows fed on fermented or other unhealthy food, milk produced in places where any contagious disease is known to exist, or any milk that does not come up to the legal standard of 12.5 per cent total solids, 3 per cent fats, and a specific gravity between 1.029 and 1.033 at 60° F., is prohibited. Skimmed milk may be sold if the packages are plainly labeled and if it has a specific gravity at 60° F. between 1.032 and 1.037.

The city expends $1,000 annually in connection with the supervision of its milk supply. One officer, an inspector, gives his entire attention to the work and one chemist part of his time. During the past year 1,219 samples of milk were examined by lactometer and the Babcock test, a part of them being analyzed gravimetrically and 850 of them being examined for preservatives; 12 bacteriological examinations were made for typhoid and tubercle bacilli; and one-half the city herds were inspected. In the two years ended June 30, 1900, 681 samples of milk were examined for preservatives and 43 of them were found to contain formaldehyde and 9 boracic acid. The milk inspector reports the results of the examination for fat and specific gravity of several samples of milk from different breeds and a few samples of fore milk and strippings.

The greatest recent improvement has been in the composition of the milk. There should be more thorough inspection of dairies, veterinary examination of all milch cows, and more care in the handling of the milk supply by producer, middleman, and retailer. Care should be taken not to license a dairy that is not capable of producing good milk.

Grand Rapids. (Population, 87,565.)

[For comparison with other cities in Class II, see p. 30.]

George F. Richardson, milk inspector.

The daily consumption of milk is estimated as 5,000 gallons, or 0.46 pint per capita, besides 500 gallons skimmed milk and 200 gallons of cream. Milk is sold from 51 licensed stores and 228 wagons. About 20 per cent of the retail trade is supplied in glass bottles, and these are filled mostly at the producing farms. The retail price of milk is 5 cents per quart in summer and 6 cents in winter, the producers on the farms receiving 2 cents in summer and 2 to 3 cents in winter. The milk from 7 well-conducted dairies near the city is sold for 6 to 8 cents per quart throughout the year. There are about 1,000 milch cows within the city limits, and milk is sent in from 228 licensed dairy farms. About 5 per cent of the supply is shipped into the city by railway, the longest shipment being 100 miles.

An ordinance adopted in October, 1897, and amended in November, 1897, refers to milk. Licenses for the sale of milk, issued annually, cost as follows: One wagon, $5; each additional wagon, $2; hand carts, $1; cans carried by hand, 50 cents; dairies and creameries, $5; private house, restaurant, etc., $1. But any farmer selling only the milk from his own cows is licensed free. Dairies and dairy herds furnishing milk must be inspected before license is granted. The use of the tuberculin test is authorized. Adulterated, etc., milk is prohibited. The milk standard is 12.5 per cent total solids, 3 per cent fat, specific gravity at 60° F. between 1.029 and 1.033. Skimmed milk must be plainly labeled.

Ordinance section regarding milk license fees is given in Appendix I (p. 178).

About $1,600 is expended annually in the supervision of the milk supply. Two officials—an inspector at $800 and an assistant at $600—give their entire time to this work. During the past year 1,500 samples of milk were examined by the Babcock test for butter fat, and the Westphal balance for specific gravity; no bacteriological examinations were made; all the city cows and all the dairy farms were inspected.

Recent improvements include better methods in the care of cows; greater cleanliness in dairies, and proper aeration and cooling of milk. It is believed an organization of milk producers and dealers should be effected to promote the common interests—encourage better methods, etc.

Saginaw. (Population, 42,345.)

No reply to inquiries was received.

Bay City. (Population, 27,628.)

[For comparison with other cities in Class III, see p. 36.]

W. H. Gilbert, milk inspector.

Daily consumption of milk is estimated as 3,000 gallons, or 0.87 pint per capita. Milk is sold from 8 stores and 28 wagons. Within the city limits there are 3 herds, including 40 cows, besides private cows kept for family use, 1 to 3 in a place. Milk is sent in from about 27 dairy farms within 6 miles of the city.

An ordinance adopted in May, 1898, regulates the sale of milk. Dairies and dairy herds supplying milk must be inspected previous to the issuing of licenses. License fee for the sale of milk is as follows: From wagons, $10 each; hand carts, $3; hand peddlers, $2; dairies or creameries, $5; restaurants, etc., $2; private houses, $1 for

each cow. Dairymen outside the city furnishing milk for city peddlers pay no license fee. The sale of adulterated, etc., milk is prohibited. Bottles used in the delivery of milk or cream must be sterilized, and the milk and cream aerated and cooled previous to bottling. The milk standard is 12.5 per cent solids, 3 per cent fat, and specific gravity at 60° F. between 1.029 and 1.033. Skimmed milk containers must be labeled.

During nine months in 1900, 168 samples of milk were examined by the Babcock test; no bacteriological examinations were made; all the city herds and all the dairy farms were inspected.

Jackson. (Population, 25,180.)

[For comparison with other cities in Class III, see p. 36.]

J. C. Harter, food and sanitary inspector.

The daily consumption of milk is estimated as 1,745 gallons, or 0.55 pint per capita. This is sold from 60 stores and 52 wagons. Nearly all the milk is delivered in glass bottles which are filled at the farms. No milk is pasteurized. The retail price of milk is 5 cents per quart throughout the year, producers receiving 2 cents in summer and 2½ cents in winter. About one-half the dairies are said to be conducted in a satisfactory manner, and one to be a "model." Within the city limits there are 8 herds, including 55 cows, and milk is brought to the city in wagons from 59 dairy farms, the longest haul being 6½ miles.

The city milk supply is under the supervision of the food and sanitary inspector. During the past year 220 samples of milk were examined by the Babcock test and gravimetric analysis; no bacteriological examinations were made; all the city herds and all the dairy farms were inspected.

Battlecreek. (Population, 18,563.)

[For comparison with other cities in Class IV, see p. 40.]

E. Cunningham, assistant milk inspector.

The daily consumption of milk is estimated as 1,400 gallons, or 0.60 pint per capita. Milk is sold from 4 stores and 26 wagons. All milk dealers deliver milk more or less in glass bottles, filled some at the farms and some in the city. A small amount of milk is pasteurized and the practice is increasing. The retail price is 5 cents per quart throughout the year, producers receiving 2 cents. Within the city there are 6 herds, and milk is brought in from 70 dairy farms within a radius of 9 miles.

An ordinance adopted in June, 1898, refers to milk. License fee for retailing milk is as follows: Milk wagons, $5; hand carts, hand peddlers, stores, etc., $2; each wagon after the first, $3. Persons having one cow are exempt from license fee. The tuberculin test is authorized in the inspection of cows. Cows must be kept in good sanitary condition and be given wholesome food. Impure, adulterated, etc., milk is prohibited. The milk standard is 12.5 per cent solids, 3 per cent fat, and specific gravity between 1.029 and 1.033. Special license is required for the sale of skimmed milk and buttermilk, and their containers must be labeled.

One hundred and thirty dollars is expended annually in the supervision of the milk supply, one official giving a part of his time to this work. During the past year 560 samples of milk were examined by lactometer and Babcock test; all the city herds and all the dairy farms were inspected.

Recent improvement in the quality of the supply is due to greater cleanliness at dairies and the aeration of the milk.

Lansing. (Population, 16,485.)

[For comparison with other cities in Class IV, see p. 40.]

V. W. Crum, M. D., health officer.

The daily consumption of milk is estimated as 1,000 gallons, or an avearge of 0.49 pint per capita, besides 100 gallons of skimmed milk and 25 gallons of cream. Milk is sold from 3 stores and 22 wagons. About one-third of it is delivered in glass bottles filled on the farms. Only a very small amount of milk is pasteurized, and the practice is not increasing. The retail price of milk is 5 cents per quart throughout the year, producers receiving 2 and 2½ cents per quart in the two seasons. Within the city limits there are 3 herds, including 32 cows, and milk is brought in wagons from 45 dairy farms, the longest haul being 4 miles.

Nine hundred dollars is expended annually in the supervision of the milk supply, one official giving his entire time to this work. During the past year 41 samples of milk were examined by lactometer and Babcock test; 4 samples were examined for tubercle bacilli; all the city herds and all the dairy farms were inspected.

MINNESOTA.

W. W. P. McConnell, State dairy commissioner, St. Paul.

General laws of 1899, chapter 257, amended, and chapter 295; and 1895, chapter 202 and chapter 203, refer to milk, etc. It is the duty of the State dairy and food commissioner to enforce all laws relating to dairy products. Persons peddling milk in cities and towns having 1,000 or more population must, every May, procure a license from the State commissioner at a cost of $1 for each vehicle; and license number, name, and business address shall be shown on vehicles. Stores, booths, etc., are licensed at the same fee. Changes of drivers or other employees must be reported. It is unlawful to sell milk or cream from milk that is unclean, unwholesome, or adulterated, or that has not been cooled or aerated, or to which preservatives or other substances have been added; or milk from cows kept in crowded, filthy, or poorly ventilated stables; or milk from cows having tuberculosis, ulcers, or other disease, or fed upon distillery waste or brewery grains, etc.; or milk from cows less than 15 days before or 5 days after parturition. The milk standard is 13 per cent solids, 3½ per cent fat. The cream standard is 20 per cent fat. Skimmed milk must be plainly labeled. Cans, bottles, etc., used in the transportation of milk over any railway or boat line must be emptied before the milk sours, and then promptly cleaned. Ordinances not conflicting with State laws may be passed by the council of any city, providing for the inspection of milk, dairies, and dairy herds within the city limits, and may require licenses (without fee) for selling milk; and inspectors, experts, etc., may be appointed for their enforcement.

The Penal Code, section 331 amended, provides that whoever adulterates milk with the intent of selling it as unadulterated, or knowingly makes such a sale, is guilty of a misdemeanor.

Dairies numbering 1,025 have been inspected in 129 cities; between 200 and 300 dairies shipping milk to these cities are not inspected.

Forms for recording data regarding milk samples are shown in Appendix IV (p. 203).

Minneapolis. (Population, 202,718.)

[For comparison with other cities in Class I, see p. 26.]

W. D. McCall, milk and bread inspector.

The daily consumption of milk is estimated as 28,000 gallons, or 1.11 pints per capita. This large amount is explained by the common use of milk by the Scandinavian element. It is estimated also that 335 gallons of skimmed milk, 3,536 gallons

of cream, and 200 gallons of buttermilk are consumed daily. Milk is sold from about 400 stores and 500 wagons. Only a small percentage of the milk is delivered in glass bottles and these are filled in the city. The trade in pasteurized milk is as yet unimportant. About half of the cream is pasteurized. The retail price of milk is 5 cents per quart in summer and 5 to 6 cents in winter, the producers receiving 2½ cents in summer and 3 cents in winter. Within the city limits there are about 2,500 cows, and perhaps half of them are kept by persons who have only 1 or 2; the total within a radius of 10 miles is 10,000, included in 450 herds. Outside the 10-mile radius there are 50 dairy farms sending milk into the city. One-fifth of the total supply of milk is received by rail, the longest shipment being 75 miles.

An ordinance to regulate the city milk supply was passed by the city council in 1895 and has since been amended three times (twelve sections). A license is required for the sale of milk; applicant must give detailed information regarding the management of the dairy whence his supply. The dairy must be inspected by a veterinarian acceptable to the health commission, and the animals must be examined for tuberculosis and other diseases. For the detection of tuberculosis the use of tuberculin is authorized[a]; this is furnished by the health department free of charge. All inspected animals are tagged to show the presence or absence of infectious disease. Investigation of dairies is reported to the city council before decision as to issuing a license is made. The license is issued without charge; it extends until the first of the following May, but can be revoked for cause. The sale of impure milk or milk from unhealthy animals is prohibited. Cows within the city must be kept clean, and they must not be fed on brewery grains or other food which will cause the milk to be unhealthy, and their drinking water must be pure. No foreign matter shall be added to milk, nor shall any constituent be removed; it must contain 13 per cent solids and 3½ per cent fat. Skimmed milk may be sold if in a vessel plainly labeled.

About $5,000 is expended annually for the supervision of the city milk supply. Three officers give their entire time and 2 part of their time to this work; these include 1 veterinarian, 1 chemist, 1 milk inspector, and 2 dairy inspectors. During the past year 3,022 samples of milk were analyzed by the Babcock test and by gravimetric analysis; a few samples were examined bacteriologically; 92 of the city herds and 99 dairy farms were inspected; 1,516 milk dealers were warned that their milk must be improved, 5 were convicted and fined for watering their milk, 1 was convicted for selling without a license, and 1 firm was convicted and fined for selling a preservative.

In the year 1900, 4,450 cows were tested with tuberculin and only 79 were condemned; this was 1.78 per cent as compared with 9 per cent in 1895, when the use of tuberculin was inaugurated. During the year 43 cows were retested; 33 of them reacted and were condemned.

The form for notice to milk dealers to display license number on delivery wagons is shown in Appendix IV (p. 00).

The most marked recent improvement is shown by the increased willingness on the part of dairymen to have their herds inspected. More well-trained inspectors are needed for the proper enforcement of the law.

St. Paul. (Population, 163,065.)

[For comparison with other cities in Class I, see p. 26.]

W. W. P. McConnell, State dairy and food commissioner.

The daily consumption of milk is estimated as 12,000 gallons, or 0.59 pint per capita, besides about 1,500 gallons of skimmed milk and 1,200 gallons of cream. Milk is distributed from 400 stores and 325 wagons. Glass bottles are used in the

[a] The right to use tuberculin was confirmed by the supreme court of Minnesota.

delivery of about one-seventh of the supply, and these are filled in the city. Ten per cent of the milk is pasteurized, and this treatment is increasing. The retail price of milk is 5 cents per quart in summer and 6 cents in winter, the producers receiving 1¾ to 2 cents in summer and 2½ to 4 cents in winter. There are no "model dairies" in the vicinity. Within the city limits and within a radius of 10 miles there are 300 dairy herds, including 6,600 head; 30 other dairy farms send milk into the city. About 20 per cent of the milk supply is received by rail, the longest shipment being 75 miles.

City ordinance No. 2042, April, 1899, regulates the milk supply. Every person selling milk is required to hold a license, application for which must be accompanied by a statement giving certain information regarding location, source of milk supply, etc. Sale may commence after application is filed and may continue unless license is refused. The dairy must be examined by an inspector, special attention being given to the health of the cattle, each one being tagged to show its condition. A charge of 50 cents per animal is made for inspection. If the inspector's report is favorable, the license is issued, to be effective one year; license number must appear in milk stores and upon delivery wagons. The use of the tuberculin test is authorized. The sale of adulterated or unwholesome milk, milk taken from diseased or unclean cows, or cows fed on fermented brewery grains or distillery waste, or given impure water, milk kept in unclean vessels or in unsanitary surroundings, or milk containing a preservative, is prohibited. The milk standard is 13 per cent solids, 3½ per cent fat. Skimmed milk may be sold if in vessels plainly labeled. Cows within the city limits must not be overcrowded or kept in badly ventilated stables.

The city expends annually about $2,000 for the improvement of its milk supply. No one official gives his entire time to this work, but various employees of the health department are detailed from time to time. During the past year more than 500 samples of milk were examined by the Babcock test, and those that did not come up to the required standard were subjected to gravimetric analysis; no bacteriological examinations were made; all of the producing dairies were inspected, many cows being examined for tuberculosis.

Lately special attention has been given to the better feeding of the cows, and proper aeration and refrigeration of the milk. Needed improvements include better sanitary conditions, greater care in handling milk, and the sterilization of all milk utensils. It is proposed to have the State provide for the payment for milch cows condemned by the city authorities on account of tuberculosis or other diseases.

Duluth. (Population, 52,969.)

[For comparison with other cities in Class II, see p. 30.]

W. W. P. McConnell, State dairy and food commissioner.

The daily consumption of milk is estimated as 4,000 gallons, or 0.60 pint per capita, besides 100 gallons of skimmed milk and 225 gallons of cream. Milk is sold from 45 stores and 95 wagons. About 3 per cent of the total supply is delivered in glass jars which are filled in the city. No milk is pasteurized. The retail price of milk is 5 cents per quart in summer and 6 cents in winter, producers receiving about 1¾ cents in summer and 2½ cents in winter. The product of one small "model dairy" is sold for 7 cents per quart throughout the year. Within the city limits there are about 100 dairy herds, including 1,100 cows, and milk is sent in from about 45 dairy farms in Minnesota and 20 in Wisconsin. About 33 per cent of the total supply is received by railway, the longest shipment being 155 miles.

The milk supply is regulated by State laws.

One official is detailed from the State dairy and food commission to Duluth and vicinity to inspect dairies, dairy cattle, milk, and other food supplies. For this work an annual salary of $1,200 is paid. During the past year 400 samples of milk

were examined by the Babcock test; no bacteriological examinations were made; all the herds in the city and all the dairy farms except those in the adjoining State were inspected.

Recently there has been a marked improvement in the character of the milk supply, due to an increased interest on the part of producers in furnishing a pure article. Suggested improvements, as given, are the refrigeration of milk during railway transportation and the inspection of milk and cream shipped from the farms out of the State.

MISSISSIPPI.

This State has no milk law.

MISSOURI.

Laws of 1891, page 163, empowers cities and towns "to license and regulate milk dairies and the sale of milk, and provide for the inspection thereof."

The supervision of market milk is left entirely to local authorities.

St. Louis. (Population, 575,238.)

[For comparison with other cities in Class I, see p. 26.]

Henry J. Helwig, M. D., milk inspector.

The daily consumption of milk is estimated as 26,375 gallons, or 0.37 pint per capita, besides 3,000 gallons of cream. No skimmed milk is used. Milk is sold from 1,987 stores and 1,109 wagons. In the delivery of milk, glass bottles are generally used, the greater part of them being filled in the city. Very little milk is pasteurized and there is no increased demand for this treatment. The retail price of milk is 5 cents per quart when delivered from the can and as high as 8 cents when in glass bottles, the producers receiving 2 to 2¾ cents, the price per quart varying according to the percentage of butter fat. Three dairies in the vicinity conduct their business in an especially satisfactory manner, and are paid as high as 12½ cents per quart for their product. Within the city limits there are 400 herds, including about 8,000 cows, and milk is sent into the city from 119 dairy farms.

Ordinance No. 20808, August, 1902, regulates the city milk supply. License to sell milk and cream at retail is $1, in addition to a semiannual license of $2.50 for each delivery vehicle; license to sell at wholesale is $25. The sale of impure, adulterated milk, milk from diseased cows, milk containing any foreign substance, or milk from cows within fifteen days before or twelve days after calving is prohibited. The milk standard is solids, 11.5 per cent; fat, 3 per cent. Cream must not contain less than 12 per cent fat. Skimmed milk (all milk containing less than 10.5 per cent total solids and 1.5 per cent fat) may be sold if in properly labeled containers and if the "Skimmed Milk" sign is displayed on wagons and in stores from which it is sold. Condensed milk must be made from pure milk. Dairies where milk is produced for use in the city must be inspected at least once a month under the direction of the city chemist. Milch cows must be free from disease. Cases of sickness of persons or animals on dairy farms must be reported. Milk must not be exposed to contagious disease, and must be cooled down to 45° F. and maintained at or below 50° F. until delivered to customers. The inspectors must give bonds to faithfully perform their duties and are given the usual authority to enter dairy premises to make inspection.

The city expends annually for the supervision of the milk supply $1,850, and 1 inspector gives his entire time to the duties of the office. During the year, 684 samples of milk were examined by lactometer and the Babcock test, and 72 bacteriological examinations were made for typhoid bacilli. About seven-eighths of the herds

within the city limits were inspected. It is admitted that the law is not well enforced. Many of the city dairies are said to use brewers' grains and to be kept in an insanitary condition, and a considerable portion of their cows are believed to be tuberculous.

The composition of the milk has recently improved. There is great need for a State sanitary officer to inspect dairies and dairy herds and to see that they are kept in good sanitary condition.

Kansas City (including Kansas City, Kans.). (Population, 215,170.)

[For comparison with other cities in Class I, see p. 26.]

R. H. Hodges, meat and milk inspector.

Population: Kansas City, Mo., 163,752; Kansas City, Kans., 51,418—total, 215,170.

The daily consumption of milk in the two cities is estimated as 25,000 gallons, or 0.93 pint per capita, besides some skimmed milk and cream. Milk is sold from 400 stores and 420 wagons. Glass bottles are used by one large concern and they are filled in the city. Trade in pasteurized milk is unimportant. The retail price of milk is 5 cents per quart in summer and 5¾ cents in winter, the producers on the farms receiving 2½ cents per quart in summer and 3 cents in winter. Two or three specially well-conducted dairies near the city sell their product for 6 cents per quart throughout the year. There are 40 herds, including 700 cows, within the city limits, and about 240 dairy farms send milk into the city. One-fifth of the total milk supply is received by railway.

Sections of the "Revised ordinances of Kansas City of 1898," referring to the milk supply, are Nos. 1015 to 1020, 1023, 1029 (amended by ordinance 11,179, March, 1899), and 1030 to 1035. License is required for the sale of milk or cream, and its number and date of expiration must be shown upon delivery wagon. Persons selling milk must furnish to the board of health a list of their supplying dairies, with a statement showing the location of stables, pastures, etc. The sale of milk or cream that is impure, adulterated, or preserved, or from a cow condemned by the health officer, is prohibited. Required standards are, for milk, 3 per cent fat; buttermilk, 9 per cent solids not fat; skimmed milk, 9 per cent solids not fat. Skimmed milk must be in a vessel plainly labeled, and when sold at retail a gummed label bearing the words "Skimmed milk" must be attached to each vessel into which it is placed. Special attention must be given to milk, cream, and buttermilk served at hotels, etc. A thorough inspection must be made every two months or oftener at all places where milk is produced for sale in the city, careful attention being given to the pastures, feeds, health of the cows, and sanitary conditions. If improvements directed are not made the sale of the milk is stopped. The manufacture, sale, or use in milk of any compound for the purpose of adulteration or preservation is prohibited. Informers are entitled to one-third of fines collected.

Ordinance section regarding inspections of dairies, etc., is given in Appendix I, (p. 179).

About $2,500 is appropriated annually for the supervision of the milk supply. One inspector and one chemist give their entire time to this work. During the past year 2,500 samples of milk were examined by the Babcock test, and deficient samples by gravimetric analysis; 125 bacteriological examinations were made for tubercle bacilli; and all the dairy herds within the city and 200 of the 240 dairy farms were inspected.

Recent improvements in the milk supply are due to the almost entire abolishment of preservatives, to an increase in the percentage of butter fat, and to better refrigeration of milk in transit. Needed improvements include advancement in the price of pure milk, enforcement of the law, and legislation regulating the equipment and conduct of dairies.

St. Joseph. (Population, 102,979.)

[For comparison with other cities in Class I, see p. 26.]

H. N. Keener, M. D., clerk of board of health.

The daily consumption of milk is estimated as 8,562 gallons, or 0.66 pint per capita, besides 4,290 gallons skimmed milk and 100 gallons cream. Milk is sold from 30 stores and 125 wagons. Little if any milk is delivered in glass jars. A small amount is pasteurized under the directions of physicians for special cases. The retail price of milk is 5 cents per quart in summer and 6⅔ cents in winter, the producers receiving 2½ cents per quart in summer and 2¾ cents in winter. There are no "model dairies" in this vicinity. Within the city limits there are 68 dairy herds, including about 1,000 head, and just outside there are 25 dairies; but the exact number of dairy farms sending milk into the city is unknown. One-eighth of the total milk supply is received by rail, the longest shipment being 50 miles.

The ordinance regulating the milk supply requires every milk and cream dealer to have a license, costing $15 per year, and every person selling milk from only 1 cow to have a license costing $2.50. Every milk dealer must register his license, together with the names and addresses of persons supplying him with milk. The legal standard for milk is 12 per cent solids, 3 per cent fat. Skimmed milk is permitted if purchasers know its character. Informers are entitled to one-third of the fines collected.

No definite fund is appropriated for the supervision of the milk supply, small amounts being set aside at intervals for this purpose. There is no official milk inspector, the little work performed being done by an officer of the board of health. During the past year only 6 samples of milk were examined by lactometer; no examinations were made for bacteria; 12 of the 68 city herds and 18 dairy farms were inspected.

Demand for a better milk supply is responsible for some recent improvement. Needed improvements include thorough inspection of all dairy herds supplying milk and the enforcement of the milk ordinances.

Joplin. (Population, 26,023.)

[For comparison with other cities in Class III, see p. 36.]

J. H. Spencer, mayor.

It is claimed that 50,000 people in and near the city are supplied with milk. The daily consumption of milk is estimated as 3,500 gallons, besides 50 gallons of skimmed milk and 25 gallons of cream. On the basis of the larger population the average consumption of milk would be 0.56 pint per capita. Milk is sold from 21 stores and 32 wagons. Glass bottles filled at the farm are used by one concern in the delivery of milk. The retail price is 5 cents per quart throughout the year. There are 5 especially well-conducted dairies, and their milk is sold at the regular price. There is only 1 dairy herd (25 cows) within the city limits. Milk is sent in from 22 dairy farms, the most distant one being 20 miles from the city.

The city has no milk ordinances.

Nothing is expended by the city for the supervision of its milk supply. During the past year no samples of milk were examined for composition, but the State veterinarian examined nearly all the herds which produce milk for the city and found no tuberculous cows.

MONTANA.

Penal Code, 1895, section 1095, makes it unlawful to keep a milch cow in a crowded or unhealthy place or in a diseased condition, or to feed such cow upon any food that produces impure or unwholesome milk.

Laws of 1901, page 66, refer to the sale of milk. It is unlawful to sell adulterated milk—milk containing any added foreign substance, or milk from a diseased cow. In cities having a population over 5,000 the milk and meat inspector must be a graduate of a veterinary medical college. He must inspect, at least once a month, all dairies supplying milk, and cows must be subjected to the tuberculin test. In cases where they are free from disease, certificates of health are given. Milk must not be exposed to infection from persons having a contagious disease. Milk utensils, etc., must be kept clean. The milk standard is 12 per cent solids, 3 per cent fat, and a specific gravity not less than 1.025.

Butte. (Population, 30,470.)

[For comparison with other cities in Class III, see p. 36.]

J. H. Cronin, sanitary inspector.

It is stated that 75,000 people in and near the city are supplied with milk. The daily consumption of milk is estimated as 7,000 gallons, besides 1,000 gallons of skimmed milk and 100 gallons of cream. On the basis of the larger population, the average consumption of milk would be 0.75 pint per capita. Milk is sold from 12 stores and 35 wagons. About 2 per cent of it is delivered in glass bottles; none is pasteurized. The retail price of milk is 10 cents per quart and cream 40 cents per quart. There are no dairy herds within the city limits. Milk is sent in from 35 dairy farms, the most distant one being 12 miles out. Only 250 gallons is received daily by railway.

A part of the time of one official is given to the supervision of the city milk supply. During the past year 350 samples of milk were examined by the Babcock test. No bacteriological examinations were made. All the dairy farms were inspected.

NEBRASKA.

S. C. Bassett, deputy State food commissioner, Lincoln.

Compiled Statutes of 1897, part 3, chapter 22, section 6898, and Laws of 1899, chapter 35, sections 1 to 4, refer to milk, etc. It is the duty of the State food commission, assisted by county attorneys, to enforce laws relating to milk and cream, and it may exercise control over milk and cream testing. No person shall, with intent to defraud, sell milk that is adulterated or skimmed, or from a diseased animal. Under authority of the law the commissioner has established the following standards: Milk, 3 per cent fat; cream, 15 per cent fat.

General Laws of 1897, chapter 99, forbid the sale of adulterated food, which term is defined at length.

The State food commission has been unable to give any attention to the subject of market milk.

Omaha. (Population, 102,555.)

[For comparison with other cities in Class I, see p. 26.]

L. K. Hutton, milk inspector.

The daily consumption of milk is estimated as 5,740 gallons, or 0.45 pint per capita, besides 200 gallons of skimmed milk and 140 gallons of cream. Milk is sold from 146 stores and 150 wagons. Glass bottles are used in the delivery of about one-fifth of the milk supply. It is estimated that 300 gallons of milk is pasteurized, and the demand for milk so treated is increasing. The retail price of milk is 5 cents per quart in summer and 6 cents in winter. Within the city limits there are 89 herds, including 2,000 cows. Nearly one-third of the total amount of milk used is received by railway, the longest shipment being 75 miles.

The ordinance regulating the sale of milk consists of thirteen sections. A license

is required for the sale of milk or cream, the fee being $10 per year for each store or wagon, but persons having less than 10 cows, and delivering by hand from a residence are required to pay only $1 per cow, and persons selling less than 10 gallons of milk per day from a store are required to pay $5. All licenses expire June 30 or December 31. Application for license must be accompanied by a statement giving certain general information. Drivers and employees must hold certificates from the board of health, these to be renewed the same as licenses. Milk wagons must carry a tin plate furnished free by the license inspector and showing license number. The ordinance forbids the sale of milk or cream which is unclean, impure, adulterated; from diseased cows or cows kept in an unclean place, or fed on distillery or brewery refuse, etc.; milk or cream which has been exposed to infection from a sick person or animal; milk from cows within fifteen days before or eight days after calving. The milk standard is 12 per cent total solids, 3 per cent fat. The cream standard is 16 per cent fat. Skimmed milk is permitted if plainly labeled. The milk inspector shall inspect all cows, dairy conditions, etc., where milk is produced for sale in the city. Cases of sickness on dairy farms shall be reported to the board of health. Distillery slops or refuse shall not be kept on dairy premises.

About $1,200 is expended annually in the supervision of the city milk supply. One inspector gives his entire time to this work. During the past year 460 samples of milk were examined by the Babcock test; all of the dairy herds in the city and 15 dairy farms were inspected.

Marked improvements have been shown in the way of cleanliness in the production of milk. Needed improvements, as stated, include the inspection of dairy herds and premises by a competent veterinarian; the whitewashing of barns; and the delivery of milk in sealed packages.

Lincoln. (Population, 40,169.)

[For comparison with other cities in Class III, see p. 35.]

Thomas H. Pratt, city clerk.

The daily consumption of milk is estimated as 3,000 gallons, or 0.60 pint per capita, besides 2,000 gallons of skimmed milk and 200 gallons of cream. Milk is sold from 25 stores; the number of wagons is not known. Five dealers deliver milk in glass bottles, some of which are filled at the farm and some at milk depots. The retail price of milk is 7 cents per quart in summer and 8 cents in winter. Four dairies near the city are conducted in a manner much superior to all others, but their milk is not sold at an extra price. There are no dairy herds within the city limits. Milk is sent in from farms within a radius of 6 miles.

The city has no milk ordinances or regulations.

Nothing has been expended in the supervision of its milk supply, and no examinations of milk samples or inspections of dairies have been made.

South Omaha. (Population, 26,001.)

[For comparison with other cities in Class III, see p. 36.]

Frank E. Jones, milk inspector.

The daily consumption of milk is estimated as 1,108 gallons, or 0.34 pint per capita, besides 30 gallons of skimmed milk and 60 gallons of cream. Milk is sold from 2 stores and 27 wagons. About 5 per cent of the milk is delivered in glass bottles, filled at the farms. At present no milk is pasteurized. The retail price of milk is 5 to 6 cents per quart in summer and 6 cents in winter, the producer receiving 3½ to 4 cents in summer and 4 cents in winter. The milk from 2 dairies, conducted in a very satisfactory manner, commands the highest price. Within the city limits there are 4 herds, including 71 cows, and milk is sent in from 22 dairy farms. One dealer receives milk by railway, the longest shipment being 30 miles.

The milk ordinance of March, 1899, regulates the sale of milk. The milk standard is 12 per cent solids, 3 per cent fat, specific gravity, 1.027 to 1.035, and cream must have 16 per cent fat.

The city expends annually about $1,000 in the supervision of its milk supply, the milk inspector giving his entire time to this work. During the past year 411 milk samples were examined by the Babcock test and lactometer. No bacteriological examinations were made. The city herds were inspected monthly, and all the dairy farms were inspected.

NEVADA.

General statutes of 1885, sections 4801 to 4809, refer to milk, etc. County milk inspectors shall be appointed by the board of county commissioners. It is unlawful, knowingly, to sell adulterated or unwholesome milk or milk from cows fed on distillery, brewery, or hotel waste, called "swill," or impure matter from stalls or stables. Skimmed milk may be sold as such. Cows producing market milk must not be kept in a crowded or unhealthy condition nor given food that will produce impure milk.

NEW HAMPSHIRE.

Public statutes of 1891—chapter 127, amended, refers to milk, etc. Boards of health of cities and selectmen of towns are placed in charge of the inspection of milk, skimmed milk, and cream, and may appoint inspectors to attend to this work. No inspector shall be paid for his services unless he is a registered chemist or holder of a certificate from the dairy department of the State agricultural college. Chiefs of police or county solicitors shall prosecute offenders. A license for the sale of milk, skimmed milk, and cream is required in all cities and towns having milk inspectors. Such license will be issued to any person who shows that he understands the business and gives reasonable assurance that the cows from which his milk is taken are healthy, properly fed, etc. The license costs $2, expires the first of each June, and is revocable for cause. Its number and owner's name must be shown on delivery vehicles and in stores. It is unlawful to sell any milk, skimmed milk, or cream that is adulterated or unwholesome, or contains a coloring matter or preservative, or milk from cows diseased or fed on refuse of breweries or distilleries or other substance which may be deleterious to their product. Milk standard, October to March, is 13 per cent solids, 9.5 per cent solids not fat, 3.5 per cent fat; April to September, 12 per cent solids, 3 per cent fat. Skimmed milk standard is 9 per cent solids not fat. The sale of milk that has been skimmed is prohibited, except from vessels plainly marked. Milk shall be sold by wine measure, and all measures used in selling milk shall have their capacity marked upon them. Milk tests by inspectors and for apportioning payments must be accurate and made by persons holding certificate of competency.

Manchester. (Population, 56,987.)

[For comparison with other cities in Class II, see p. 30.]

Joseph H. Geisel, milk inspector.

The daily consumption of milk is estimated as 4,000 gallons, or 0.56 pint per capita. This is sold from 100 stores and 115 wagons. Almost all the milk is delivered in glass bottles, some of which are filled in the city and some in the country. Very little milk is pasteurized. The retail price of milk is 5 cents per quart in summer and 5 to 6 cents in winter, producers receiving 2½ to 3 cents throughout the year. There are no "model dairies" near the city. There are no herds of milch cows in the city. Milk is sent in from 150 dairy farms, all being within a radius of 18 miles.

State laws regulate the city milk supply.

Three hundred dollars is expended annually in the supervision of the milk supply, one inspector giving a part of his time to this work. During the past year 140 samples of milk were examined by the lactometer.

NEW JERSEY.

George W. McGuire, chief inspector of foods and drugs, Trenton.

Public laws of 1894, chapter 317; 1893, chapter 207; 1891, chapter 210 and chapter 257; 1888, page 461, section 2; 1883, chapter 68 and chapter 185; and an act approved March 21, 1901, refer to milk. The enforcement of the milk laws is charged to the chief inspector, under the direction of the State board of health. City boards of health shall require the registry of all cattle in the different cities, and may order inspections for disease when deemed necessary, and State officials may declare the product of diseased animals unfit for use. A commission is authorized to investigate and provide safeguards against tuberculosis. Cows producing market milk must not be kept in a crowded or unhealthy place, or fed swill or any putrefying substance, etc. Milk must not be exposed to infection from persons having a contagious disease. Samples of milk shall be taken in duplicate, etc., and analyzed at the State agricultural experiment station. Milk changed by the addition of water or other substance shall not be sold in any city of the first class. All cans and bottles in which skimmed milk is sold must be plainly marked. It is unlawful for any person to use a milk can belonging to another without his consent. The sale of food deemed to be impure according to numerous detailed definitions is forbidden.

Very few cities have taken advantage of the State laws regarding milk.

The form for reporting conditions at dairies and methods of handling milk is shown in Appendix IV, (p. 197).

The form for recording inspection of milk depots is shown in Appendix IV (p. 207).

Newark. (Population, 246,070.)

[For comparison with other cities in Class I, see p. 26.]

William H. Lyle, milk inspector.

The daily consumption of milk is estimated at 16,000 gallons, or 0.52 pint per capita, besides 1,200 gallons of cream and a small amount of skimmed milk used by bakers. Milk is sold from 800 stores and 279 wagons. About one-fourth of the supply is delivered in glass bottles, most of these being filled at the producing farms. Little or no milk is pasteurized. The retail price of milk is 6 cents per quart in summer and 7 cents in winter, and the producers receive 2½ cents in summer and 3½ cents in winter. A few well-conducted dairies near the city sell their product for 8 to 12 cents per quart throughout the year. There are in the city 58 herds, including 562 cows, besides 312 cows in private stables. About 500 dairy farms send milk into the city. It is estimated that 60 per cent of the total milk supply is received by rail, the longest shipment being 312 miles.

The sanitary code adopted by the city board of health in June, 1888, contains a few sections (XXVI, LX, LXVI, and LXVII) referring to the milk supply. An annual permit costing 10 cents is required for each animal kept within the city limits, but no license is necessary for the sale of milk. The law requires, also, that all stables and lots where animals are kept be in good sanitary condition, particularly that all manures be removed and the premises kept clean and properly drained. Milk exposed where any communicable disease exists is prohibited.

The city expends annually $2,000 in the supervision of the milk supply. One inspector gives his entire time, and the chemist and bacteriologist of the board of health a part of their time to this work. During the past year 3,508 samples were

examined by the lactometer, and 283 by the Babcock test and gravimetric analysis. No bacteriological examinations were made. Only the dairy herds within the city were inspected by city officials, those outside coming under the jurisdiction of the State authorities.

Of the 283 samples of milk analyzed, 185 contained more than 12.5 per cent total solids, 61 contained from 12 to 12.5 per cent total solids, and 37 contained less than 12 per cent total solids, the poorest showing 10.62 per cent. The lowest fat content was 2.4 per cent. As these samples were taken at random, the results of their examination may be understood to show fairly the composition of the entire supply. It is stated that the moral effect of taking samples promiscuously is good. It is the practice of the milk inspectors to take several samples at each place visited, only those suspected being taken in duplicate. The following table shows the results of the analyses made in 1900 compared with those made in the three preceding years:

	1897	1898	1899	1900
Number of samples analyzed	136	178	221	283
First class (total solids over 12.5 per cent):				
Percentage of samples	69.12	70.22	72.40	65.37
Average per cent of total solids	13.24	13.24	13.06	13.24
Average per cent of fat	.....	.....	3.95	4.06
Second class (total solids between 12.5 and 12 per cent):				
Percentage of samples	21.32	14.15	15.38	21.55
Average per cent of total solids	12.23	12.35	12.27	12.25
Average per cent of fat	.....	.....	3.60	3.56
Third class (total solids below 12 per cent):				
Percentage of samples	9.56	15.73	12.22	13.07
Average per cent of total solids	11.61	11.58	11.48	11.56
Average per cent of fat	.....	.....	3.11	3.25
General average per cent of total solids	12.87	12.82	12.75	12.77
General average per cent of fat	.....	.....	3.80	3.85

Only two samples of milk were found to contain formaldehyde.

The details of the work performed in 1897 in connection with the supervision of the milk supply were reported as follows:

	Number.
Wagons halted for inspection	1,456
Cans of milk inspected on same	3,039
Lactometer tests	1,287
Stores visited	1,472
Depots visited	13
Cans of milk inspected from same	1,385
Lactometer tests	647
Samples submitted to chemists for analysis	135
Samples of ice taken	1
Samples of milk delivered to bacteriologist for analysis	4
Cow-stable inspections	271
Animal permits issued	350
Animals licensed	1,176

The health officer calls attention to the fact that there has been great improvement in the composition of milk since ten years ago, when samples below standard were frequently found to have less than 11 per cent total solids and sometimes as low as 7 per cent.

The forms for recording data regarding milk samples and the form for notification of the taking of a sample are shown in Appendix IV (pp. 205 and 206).

Needed improvements include the enactment of a law requiring dealers to be licensed, and a more thorough and systematic inspection of dairies and dairy products.

Reference is made to a few dairies which produce milk of extra good quality and receive an extra price for it. Special mention should be made of one of these, which for several years has been operated in accordance with an agreement with a milk commission in Essex County. This commission and its work are referred to on pages 173 and 174 of the Seventeenth Annual Report of the Bureau of Animal Industry. Undoubtedly it deserves credit for the high quality of much of the milk sold in the vicinity of Newark, and much credit also for the establishment of milk commissions working along similar lines elsewhere.

The contract between the milk commission and the dairyman is shown in Appendix III (p. 182).

Jersey City. (Population, 206,433.)

[For comparison with other cities in Class I, see p. 26.]

D. W. Benjamin, M. D., health inspector.

John C. Tracy, assistant State dairy commissioner.

The daily consumption of milk is estimated as 12,000 gallons, or 0.47 pint per capita. No skimmed milk is used, but it is estimated that there are 500 gallons of cream consumed daily. Milk is sold from 450 stores and 250 wagons. Glass bottles are used in the delivery of about one-half of the total supply, and these are filled, some on the farms, some at the stores, and some on the wagons. Only a little pasteurized milk is used. The retail price of milk is 6 to 8 cents per quart in summer and 7 to 8 cents in winter. There are no "model dairies" supplying milk to the city. Within the city limits there are 30 herds, including 275 cows; no data is available as to the number of dairy farms sending milk into the city. The greater part of the total milk supply is received by rail, the longest shipment being 250 miles.

The city authorities have made no provisions for the regulation of the milk supply, its supervision being left to the State.

During the past year about 500 samples of milk were examined by lactometer, and some of them by gravimetric analysis; no bacteriological examinations were made; all the city herds were inspected.

It is urged that a competent milk inspector should be appointed to work under the direction of the city board of health.

Paterson. (Population, 105,171.)

[For comparison with other cities in Class I, see p. 26.]

James P. McNair, secretary of the board of health.

The daily consumption of milk is estimated as 8,000 gallons, or 0.61 pint per capita, besides 200 gallons of cream. The use of skimmed milk is not known to the authorities. Milk is distributed from 225 stores; the number of wagons is not known. About one-eighth of the milk is delivered in glass bottles, being the output of four dairy establishments, two in the city and two in the country. Very little milk is pasteurized. The retail price of milk is 6 to 8 cents per quart both in summer and winter, the producers receiving 3 to 4 cents per quart in summer and 3 to 5 cents in winter. There are two establishments near the city, managed in an up-to-date manner, which sell their entire product for 10 cents per quart in summer and 12 cents in winter. Within the city limits there are 84 herds, including 423 cows; the number

of the dairy farms sending milk into the city is unknown. It is estimated that 16 per cent of the milk is brought into the city by rail, the longest shipment being 42 miles.

The city has no milk ordinances or regulations.

Nothing has been expended in the supervision of the milk supply, and no examinations of milk samples or inspections of country dairies have been made. The dairies in the city have been inspected.

Needed improvements include the appointment of milk inspectors, the requirement that all milk dealers be licensed by the board of health, and an ordinance establishing a standard for milk and regulating its sale and delivery.

Camden. (Population, 75,935.)

[For comparison with other cities in Class II, see p. 30.]

J. O. George, D. V. S., food and milk inspector.

The daily consumption of milk is estimated as 4,000 gallons, or 0.42 pint per capita, besides 125 gallons of skimmed milk and 100 gallons of cream. Milk is sold from 128 stores and 75 wagons. Two dairymen supply milk in glass jars, using about 700 bottles daily; one fills his bottles in the city, the other at the producing farm. No milk is pasteurized. The retail price of milk is 8 cents per quart throughout the year, producers receiving 3 to 3½ cents in summer and 3½ to 4 cents in winter. There are no herds of milch cows in the city, the milk being sent in from 113 dairy farms. Almost the total supply is received by railway, the longest shipment being 30 miles.

About $1,200 is expended annually in the supervision of the city milk supply. One milk and food inspector and one chemist give a part of their time to this work. During the past year 550 samples of milk were examined by lactometer and by gravimetric analysis; a large number of tests were made for formaldehyde; no bacteriological examinations were made; and no dairy farms were inspected.

Recent improvement is due to the introduction of cows giving richer milk; better feeding; and a more careful handling of the milk. Needed improvements, as given, include a thorough inspection of all milch cows for tuberculosis and better care of the milk.

Trenton. (Population, 73,307.)

[For comparison with other cities in Class II, see p. 30.]

A. S. Fell, M. D., health officer.

George W. McGuire, State dairy commissioner.

The daily consumption of milk is estimated as 4,500 gallons, or 0.49 pint per capita. Milk is sold from 25 stores and 130 wagons. Fifty per cent of the total supply is delivered in glass bottles, some of them being filled in the city and some in the country. No milk is pasteurized. The retail price of milk is 6 cents per quart in summer and 8 cents in winter, the producers on the farm being paid 3 cents in summer and 4 cents in winter. There are 3 well-conducted dairies near the city which receive the regular retail price for their product. There is only one herd of cows in the city, and it includes 20 head. One hundred and fifty dairy farms send milk into the city. About 5 per cent of the total supply is received by railway, the longest shipment being 20 miles.

Nothing is expended by the city in the supervision of its milk supply, this work being under State control. During the past year 100 samples were examined by lactometer and gravimetric analysis; no bacteriological examinations were made; about 20 per cent of the dairy farms were inspected.

Recently the milk supply has been found to be practically free from preservatives, and has shown general improvement otherwise.

Hoboken. (Population, 59,364.)

[For comparison with other cities in Class II, see p. 30.]

Antonio Granelli, health inspector.

The daily sales of milk are estimated to be 8,750 gallons, but these include some duplications, recording the same milk sold both at wholesale and retail. Consequently the average daily per capita consumption is actually less than 1.21 pints, as would appear from the reports. Milk is sold from 243 stores and 24 wagons. The retail price of milk varies from 3 to 6 cents per quart in summer and 4 to 8 cents in winter.

An ordinance passed September, 1897, refers to milk. A permit costing $1 is required for the sale of milk. Milk vessels must be kept clean. Adulterated, impure, etc., milk is prohibited. The milk standard is 12 per cent solids, 3 per cent fat.

Nothing is expended by the city in the supervision of its milk supply.

The inspector recommends that milk be shipped from the farms in sealed packages.

Elizabeth. (Population, 52,130.)

[For comparison with other cities in Class II, see p. 30.]

John C. Tracy, assistant State dairy inspector.

The daily consumption of milk is estimated as 13,062 gallons, or 2 pints per capita. No explanation of this apparently very large consumption of milk is given; it may be due to the fact that some milk is forwarded to other cities. No skimmed milk is used. Milk is sold from 25 stores and 50 wagons. Only a small quantity is delivered in glass bottles and these are filled at the producing farms, and none is pasteurized. The retail price of milk is 6 cents per quart in summer and 8 cents in winter, producers receiving 3 and 4 cents in the two seasons. There are no "model dairies" near the city. Within the city limits there are 10 herds of milch cows, including 100 head, and milk is sent in from 55 dairy farms. A very small portion of the total supply is received by railway, the longest shipment being 5 miles.

An ordinance adopted in March, 1899, supplements the State laws. City cow stables must be kept in a good sanitary condition and be provided with underground manure vaults. Unwholesome milk is prohibited. Milk, when offered for sale, must not be misrepresented.

Nothing is expended by the city in the supervision of its milk supply, this work being under State control. During the past year a number of milk samples were examined by the lactometer; no bacteriologial examinations were made; all the city milch cows and all the dairy farms sending milk into the city were inspected.

Bayonne. (Population, 32,772.)

[For comparison with other cities in Class III, see p. 36.]

A. C. Torman, health inspector.

About 1,800 gallons of milk is used daily, which is an average per capita consumption of 0.50 pint. Milk is sold from 130 stores and 35 wagons. The farthest distance from which it is supplied is 40 miles. Four herds are in the city, including about 125 cows.

The sanitary code of the board of health adopted in March, 1899, refers to milk. Milk venders must obtain a permit costing $2. The sale of adulterated, etc., milk is prohibited. The milk standard is 12 per cent solids, 3 per cent fat.

There is no milk inspector and no samples of milk have been examined for composition, but all the city herds have been inspected.

Atlantic City. (Population, 27,838.)

[For comparison with other cities in Class III, see p. 36.]

H. C. Beck, health inspector.

Milk is sold from 30 stores and 50 wagons. Glass bottles, filled mostly in the city, are used extensively in the delivery of milk. Little or no milk is pasteurized. The retail price of milk is 8 cents per quart throughout the year, producers receiving 4 cents per quart. There are a few well-conducted dairies near the city, but their product is not sold at an advance in price. The total milk supply is received by railway, the longest shipment being 50 miles.

Nothing is expended by the city in the supervision of its milk supply, this work being under State officials.

Passaic. (Population, 27,777.)

[For comparison with other cities in Class III, see p. 36.]

J. Payne Lowe, D. V. S., veterinary inspector.

The retail price of milk is 5 to 8 cents per quart throughout the year. The milk from one "model dairy" is sold at an advanced price. Within the city limits there are 43 herds, including 122 cows. Over two-thirds of the total milk supply is received by railway, the longest shipment being 100 miles.

The veterinary inspector gives a part of his time to the supervision of the milk supply. During the past year samples of milk were examined by the lactometer; no bacteriological examinations were made; all the city herds were inspected, but none of the dairy farms.

It is urged that some provisions be made by which health authorities in the districts where milk is produced would report upon conditions of herds, methods of handling milk, etc.

New Brunswick. (Population, 20,006.)

[For comparison with other cities in Class IV, see p. 40.]

Henry R. Baldwin, M. D., president of the board of health.

The daily consumption of milk is estimated as 1,250 gallons, or an average of 0.50 pint per capita. Milk is sold from about 30 stores and 30 wagons. About one-fifth is delivered in glass bottles, and these are filled at the farm. Pasteurized milk is used only to a limited extent. The retail price of milk is 4 to 6 cents per quart in summer and 5 to 8 cents in winter, producers receiving 3 cents and 3½ cents in the two seasons. The milk from one "model dairy" is sold for 6 cents in summer and 8 cents in winter. Within the city limits there are 5 herds, including 70 cows, and milk is sent in from about 55 dairy farms, all within 6 miles of the city.

The city has no milk ordinance.

Nothing is appropriated by the city for the supervision of its milk supply. During the past year 3,500 samples were examined by the Babcock test, and 2 of the 60 dairy herds were inspected. The sale of milk from the well-conducted dairy belonging to the State agricultural college has had a marked effect in bringing about improvement in the city supply.

Recent improvement in the milk supply is due to better care and feeding of cows and to greater cleanliness of dairies.

Montclair. (Population, 13,962.)

[For comparison with other cities in Class IV, see p. 40.]

M. O. Leighton, health inspector.

The daily consumption of milk is estimated as 860 gallons, or 0.49 pint per capita. Little or no skimmed milk is sold. Milk is sold from 12 stores and 32 wagons. All the milk is delivered in glass bottles and almost all of these are filled at the farms. No milk is pasteurized. The retail price is 7 to 12 cents per quart throughout the year, producers receiving 2 to 3½ cents. The milk from 6 "model dairies" is sold

for 8 to 12 cents per quart. Within the city limits there are 4 herds, including 35 cows, and milk is sent in from 24 dairy farms. About 20 per cent is received by railway, the longest shipment being 400 miles. Quite a large part of the supply comes from Chenango County, N. Y.

An ordinance adopted in March, 1898, refers to milk. Persons selling milk must register with the board of health. Cow stables must be properly located and constructed and be kept clean. Cows must be free from dangerous disease, be kept clean, and their udders washed and wiped before each milking. Attendants must personally be clean and not exposed to contagious disease. Milk must be removed to separate room at once after milking and be cooled in water. Milk utensils must be washed in pure water and soda or soap, and be sterilized.

The milk ordinance is given in full in Appendix I (p. 175).

About $300 is expended annually in the supervision of the milk supply, two officials giving a part of their time to this work. During the past year 166 samples of milk were examined by lactometer, Babcock test, and gravimetric analysis; the same number was examined for bacterial content; all the city herds and all the dairy farms were inspected each month. The results of chemical and bacteriological examinations of milk and accounts of conditions found at dairies are published in the annual reports of the board of health, together with the names and addresses of the dairymen whose products and places are referred to. The reports are widely distributed, and read by many citizens. The statement of the conditions found at one dairy is as follows: Large, light stable; good drainage, and kept in excellent condition. Cement floors and drops. About 20 cattle, regularly attended by a veterinarian. Milk cooled over patent cooler and bottled immediately. Utensils sterilized with steam.

The supervision by the milk commission, referred to in the statement under Newark, extends to a portion of the milk sold in Montclair, and has had considerable effect in raising the standard of the supply of this city.

Recent improvements are due to the observance of better methods at producing dairies. Further improvement would undoubtedly follow if the actual facts in connection with different dairies were published in the newspapers.

In a paper upon "The importance of bacterial counts in the sanitary supervision of milk supplies" the health inspector presents, in an interesting manner, the results of his study of the subject. His investigations extended over a period of two or three years, and proved to his satisfaction that the sanitary condition of dairies can be safely judged by the number of bacteria in the product. All the samples of milk which he examined in this connection had been bottled at the dairies, and so far as possible they were taken from the evening milking, their age, when examined, being twelve to fifteen hours; in some cases they were older. Regarding his experiments and conclusions he writes as follows:

"The time covered by the work is three successive years from September to June. The bacteria were grown upon gelatin, and each culture was allowed to grow nearly to the point of liquefaction so that the slow-growing colonies would have all the time possible to increase to the counting size.

TABLE 1.—*Average results.*

No. of specimen.	Number of bacteria.	No. of specimen.	Number of bacteria.	No. of specimen.	Number of bacteria.
1	5,006	7	28,654	13	182,012
2	8,770	8	41,629	14	257,004
3	9,900	9	50,320	15	Uncountable.
4	13,762	10	62,269	16	Uncountable.
5	14,250	11	65,633	17	Uncountable.
6	21,012	12	69,973		

"Table No. 1 contains the average results of the determinations for each dairy during the whole term. Examination shows that the figures range from 5,006 in No. 1 to uncountable in the last three; also that the list divides itself into three classes: Nos. 1–5, or those having a count below 15,000; Nos. 8–12, or those running from 40,000 to 70,000; and, after a long interval, those dairies having an average of 180,000 and upward. Nos. 6 and 7 do not appear to be in any class, having a position intermediate between the first and second classes. A possible reason for the eccentric position of these two dairies may be drawn from considerations which are to follow.

"Table No. 2 includes the results of the examinations which, taken together, make the averages for the dairies in the first class above described.

"The number of the dairy according to its succession is set at the top of the record of determinations, while the average in each case is set at the bottom.

TABLE 2.—*First class; individual results.*

No. 1.	No. 2.	No. 3.	No. 4.	No. 5.
2,366	9,500	6,800	2,000	96,700
5,800	1,900	6,400	4,200	7,700
5,800	11,600	3,500	6,200	25,250
5,000	22,500	2,200	12,700	12,900
3,600	4,300	34,700	11,200	8,300
2,800	6,300	2,800	8,800	2,000
8,000	16,800	12,000	34,600	3,600
4,000	9,600	30,300	29,600	1,500
3,400	13,500	10,900	.....	2,800
3,500	8,000	7,600	.....	21,200
6,700	13,300	1,600	.....	18,400
5,800	17,600	3,800	.....	7,300
5,800	600	7,300	.....	6,300
5,450	700	8,700	.....	6,100
6,600	3,620	.....	.....	16,800
4,600	3,620	.....	.....	6,800
5,100	11,560	.....	.....	8,600
.....	9,840	.....	.....	.....
.....	4,300	.....	.....	.....
.....	5,300	.....	.....	.....
5,006	8,770	9,900	13,762	14,250

"Representing dairy No. 1 are the results of seventeen examinations, ranging from 2,366 to 8,000, and showing a remarkable degree of uniformity throughout. It is evident that whatever may be the conditions to produce these results, those conditions are uniform. This seems to be exemplified, though less imperfectly, in the remaining columns of the table. Note in No. 2 that some of the determinations are lower than any in No. 1, but there is a wider range of figures, and some of the determinations are above the 15,000 limit which marks this class. Nos. 3 and 4 are similar. No. 5 starts with the abnormally high count of 96,700, but does not approach it again in the remainder of the list. It is evident that a remarkable change took place in the conditions within and surrounding this dairy after the first examination.

"Inspection of the dairies which these diagrams represent would show that Nos. 1, 2, and 4 are very similar, and are of the highest type of dairy excellence. The stables are built upon elevated situations, where good drainage can be secured. Inside the stables there is ample provision for light and ventilation, while the floors and manure troughs are built in such a manner and of such materials as will facili-

tate cleaning. The cattle in these stables are carefully groomed, fed upon wholesome food, and regularly attended by a veterinarian. The attendants employed are kept personally clean, and are provided with every facility for maintaining their cleanly condition throughout the milking period. Of highest importance are the dairy houses in connection with these first three establishments. In them are provided tight steam chests, in which all utensils necessary in the preparation of the product for the market are exposed to steam under pressure and thoroughly sterilized. The other principal features in connection with the dairy houses are the coolers over which the milk flows as soon as it is drawn from the cows, from whence it goes to the bottler and is bottled immediately.

"Dairy No. 3 differs from the first two and the fourth only in this respect: The milk is raised by different farmers in a district, who sell it to a company which takes charge of the bottling and final delivery to the consumer. The condition of all branches of the process is, however, in no wise different in its sanitary and hygienic features from Nos. 1, 2, and 4.

"Dairy No. 5 differs from the first four in that the latter are the results of the expenditure of a large amount of money. There have been installed within them numerous devices to produce facility and economy, as well as cleanliness in handling the product. From this it might be supposed that it is only in dairies of this character that we are able to procure low counts. Such, however, is not the case. Of course, it is easier to keep clean in a palace than in a hovel, yet it must be admitted that cleanliness is not an impossibility even in the latter place. Dairy No. 5 consists of low, old-fashioned stables, which at first glance exhibit nothing favorable, but within which close inspection will reveal the vigilance of the owner. In spite of the rough projections, innumerable cracks, and all the disadvantages common to country stables, there are evidences of care and attention everywhere. The explanation to him of the first high results noted at the beginning of the record brought about all the alterations suggested. The owner is an ideal dairyman in spite of his poverty.

TABLE 3.—*Individual results.*

No. 6.	No. 7.	No. 6.	No. 7.
59,600	6,100	38,000	41,900
20,500	6,600	45,000	81,600
1,290	4,400	48,000	101,500
10,300	4,750	12,400	.....
2,300	12,300	13,500	.....
2,600	25,300	2,900	.....
22,800	10,300	3,400	.....
16,000	13,500	21,012	28,654
37,600	35,600		

"Considering, now, the two dairies which were intermediate between the first and second classes, it will be seen that for dairy No. 6, in the table immediately above, there are widely varying results, generally high and spasmodically low; a column of figures without uniformity and with extremes which are bewildering when compared with the table of the first class of dairies.

"It has been observed that costly stables and expensive equipment are not indispensable for procuring clean milk and low bacterial counts. It is also true that the possession of all these does not insure the best results. Number 6 is a dairy which should belong to the first class, having clean, light, well-made stables and carefully chosen cattle, and a complete sterilizing and bottling equipment. At first thought it contradicts what has gone before, but if one should watch the dairy in operation

for several days he would learn that the proprietors have many interests outside of the dairy inclosure, and are fond of many diversions. Consequently, the work is too often left without their care, and the employees, being possessed of their full complement of human frailties, are not in good form at those times. Milking is done carelessly, cooling and bottling deferred, and cattle go ungroomed. Vigilance there comes only in spasmodical waves.

"In dairy No. 7, Table 3, the list starts out very evenly, with low counts, which would, if continued, have placed the dairy well within the first class. The premises at first presented a neat, wholesome appearance, quite in keeping with the record made at that time. Those who are acquainted with the owner know that he has experienced sorrow in his family and adversity in his worldly affairs; a man who has, under the stress of this condition, become careless and indifferent. The ready-made sound which this statement has is quite appreciable to the writer, yet these conditions do actually exist and are well known in the neighborhood in which he lives. The stables, once a model of neatness, have gradually assumed a meaner aspect, and the cattle, once so well-rounded, have become rough, ill-kempt, and angular. The man's condition is stamped upon his features, is evident in his personal appearance, and can be seen even in his driveway and door-yard. From the foregoing it therefore becomes plain that low results, coincident with prosperous times and the high ones which followed adversity, make an average which conforms neither to the one condition nor to the other.

TABLE 4.—*Second class; individual results.*

No. 8.	No. 9.	No. 10.	No. 11.	No. 12.
16,600	36,750	390,000	72,600	33,300
16,100	72,600	9,850	15,700	35,100
61,800	7,800	7,600	19,937	23,000
64,350	299,450	7,700	126,300	44,350
19,600	16,200	81,700	107,500	400,000
14,000	39,000	9,600	85,500	40,000
120,000	10,700	8,800	83,200	42,400
80,000	16,000	82,900	125,400	60,000
50,400	20,800	.....	93,600	55,000
48,300	13,500	.....	42,000	76,300
41,000	7,800	.....	43,300	81,200
43,000	9,000	.....	16,900	12,900
.....	30,100	.....	17,800	6,100
.....	99,000	.....	.....	.....
.....	86,100	.....	.....	.....
41,629	50,320	62,269	65,633	69,973

"Passing to the second class of dairies, it is seen from Table No. 4 that the averages extend from 41,629 to 69,973. Those who have been engaged in dairy inspection, even to a small extent, know that dairy farmers as a class are poor in money but wonderfully rich in good intentions. There are many old stables which are kept very clean with shovel and broom, and in which cattle are treated according to the golden rule. There are supplied no sterilizer, no improved cooler, no chert[a] floors, but the farmer is always doing his best with the means at his disposal. He cools his milk by standing the can containing it in a tub of water; he washes his utensils as clean as possible with water and soap, and he keeps himself and his employees personally clean. Such cases are common, where a man tries to compen-

[a] Chert floor is a smooth cement floor.

sate with muscle labor for that which he has not money to purchase. Such instances are represented in the second class. In the results there is little uniformity; occasionally there is a low count which seems to be the result of a happy combination of good effort and good fortune. And so it is that there is lacking in the records of these dairies the uniformity which appeared so distinctively in Table No. 2. Favorable conditions come and go in the dairy business, just as in other vocations, and with no devices with which to overcome the numerous difficulties which arise before one who attempts to produce an honest product, there can not be placed any great dependence upon the uniform excellence of the milk.

"A comparison between these dairies and dairy No. 5 is instructive. Structurally, the former are generally no poorer than the latter, yet if we look closely into the existing conditions we will find that in these stables of the second class the whole atmosphere is inferior. The cattle look rougher and dirtier, accumulations of manure will more often collect upon the sides of the stables, the milk bottles, when ready for filling, shine less brightly, and the owners themselves appear not as tidy as the owner of No. 5. The matter of personal appearance in a dairyman is extremely significant in indicating the quality of that man's product. If the owners of the dairies here described should be arranged in a line according to their personal appearance the order of succession would very closely follow the bacterial order here given:

TABLE 5.—*Third class; individual results.*

No. 13.	No. 14.	No. 15.	No. 16.	No. 17.
72,600	48,000	Uncountable.	431,900	114,300
59,400	299,000	80,000	275,500	19,550
404,700	178,000	62,400	17,300	22,800
455,000	583,000	120,800	12,500	156,000
37,600	720,000	60,000	Uncountable.	53,000
33,800	800,000	Uncountable.	19,900	Uncountable.
25,300	120,000	Uncountable.	20,500	Uncountable.
67,700	160,000	.....	130,000	.....
.....	22,000	.....	Uncountable.	.....
.....	25,600	.....	17,000	.....
.....	31,500	.....	.....	.....
.....	96,000	.....	.....	.....
182,012	257,004	.....	.....	.....

"The consideration of the third class of dairies introduces the discussion of the two factors which lie at the bottom of conditions in dairies totally bad. The first is dense ignorance and total unfitness of the man for the business; men who, perchance, have failed in every other capacity by which they have been measured during life; men of foul habits and disgusting personality, whom we would not tolerate in the meanest capacity about our homes or in our places of business. Such are the men who take a part in the production of one of our most important food supplies. The second factor responsible for bad results in a dairy is vicious indifference and sordid opposition to decency on the part of producers who are really intelligent and capable. With these it is considered meritorious to violate, as far as is legally safe, the ordinance and wishes of the sanitary authorities. To such people the voice of an instructor of hygienic dairying is ever the voice of a meddlesome oppressor, and is to be met only by opposition.

"A good example of the results obtained by the totally ignorant dairyman may

be seen in the record of No. 14. The owner of this dairy is good natured, stupid, and lazy, and is therefore a hard man to manage. He seems perfectly willing to lie down and be kicked at any time, and then, bearing you no ill will, and doubting not the wisdom of your procedure, he will go on just as before. The improvement that is noted in the latter part of his record is the result of extensive structural improvements in the stable. But as the effect of renovation gradually wore away, and the man relapsed into long-imbued habits, the record took a corresponding trend toward the old high average.

"In conclusion it may be said, that the correspondence which exists between the results of the numerical determinations of bacteria and the conditions under which each supply is produced, are most striking when the dairies themselves are visited. Verbal descriptions and pictorial presentations are inadequate to complete in the mind the principle involved. These determinations, as well as the results of the physical and chemical tests, have been published, each under the name of the dairyman in the annual reports of the Montclair board of health. They have brought the facts before the people in no uncertain manner, and the people have profited largely from it. Those who have appeared favorably in these reports have been blessed with increased trade, while on the other hand, many of the slovenly ones have found their business unprofitable. In addition to this, the improvements which have been made to the dairies, both in structure and in methods of procedure, are too numerous to mention here. Laws and ordinances accomplish their part in bringing our milk supplies up to the point where they are respectable, but it has been the experience of the writer that nothing is quite so effectual as fearless, truthful publicity.

"From the foregoing results, we are able to come to but one conclusion—i. e., that the number of bacteria per cubic centimeter in a given sample of milk forms an absolute indicator, by which the care and cleanliness to which the product has been subjected from the time it is drawn to its delivery into the hands of the analyst may be determined. In reply to the authoritative statements mentioned in the beginning, the writer can simply point to these results and declare that if all this be coincidence, then coincidence must be predetermined."

NEW MEXICO.

Compiled laws of 1897—sections 1244 to 1257 refer to foods. No person shall knowingly sell a damaged or altered food without the purchaser being fully informed.

NEW YORK.

Charles A. Wieting, commissioner of agriculture, Albany.

Laws of 1893, chapter 338 (chap. 33 G. L.), article 1, sections 1 to 12, and article 2, sections 20 to 25, amended, refer to milk. The State department of agriculture is charged with the execution of laws relating to agricultural products. Samples must be taken in duplicate, etc. No person shall sell adulterated milk, meaning milk that is from cows within fifteen days before and five days after parturition, milk from animals fed on distillery waste or any putrefying substance, milk from cows in crowded or unhealthy condition, or milk to which water or any foreign substance has been added. Preservatives are prohibited. Pure milk is defined as sweet and unadulterated; pure cream is that taken from such milk. The milk standard is 12 per cent solids, 3 per cent fat. Except in New York and Kings counties, skimmed milk is permitted when clean and wholesome and sold for what it is, but it can be sold only in the county where produced or an adjoining county. Milk cans, etc., holding market milk and rooms where it is stored must be kept clean and sanitary; but this provision does not apply to cities of the first class. No person shall use the cans of

another without the owner's consent, or remove therefrom or mar his name or mark. Condensed milk must be made from pure and wholesome milk, a standard being fixed, and all packages shall be labeled with the name of the manufacturer, etc.

Laws of 1901, volume 2, chapter 429: Impure, unhealthy, adulterated, etc., milk must not be supplied to butter or cheese factories. Babcock glassware used in making milk tests for the basis of payment must first be examined and marked by the director of the New York agricultural experiment station.

For the purpose of enforcing the laws and performing other work charged to it, the department of agriculture has placed an assistant commissioner in each of the 10 divisions into which the State has been divided, and among other duties these officials execute State laws relating to milk. They do not collect statistics relative to city and town milk supply, but so far as possible, they inspect milk sold in cities and towns, and visit milk stations for the purpose of inspecting milk, etc., always going to such stations when requested to do so. Their visits are irregular. Milk is tested with lactometer, and, if suspicious, duplicate samples are taken for analysis—one for the State and one for the owner. Inspectors visit farms suspected of being in bad order. Bacteriological examinations are ocassionally made by the analysts at the State agricultural college.

In some of the large cities the department's agents inspect milk almost daily. In Albany the department has a wagon especially fitted up with facilities for making quick tests, and it is out each day, sometimes going to neighboring towns. Usually the milk in every can in the peddler's wagon is tested. In one summer month 740 cans were examined in Albany and only 3 suspected samples taken. Agents send detailed reports of work done to the department each week.

The number of prosecutions under the milk law in District I, including 7 counties in the central eastern portion of the State in the year 1900, is shown by the following:

Troy	13	Schenectady	10	Cohoes	3
Albany	15	Mechanicsville	1	Stillwater	1
East Greenbush	3	Round Lake	1	Amsterdam	1
Milford	3	Eagleville	1	Richfield	1
Beckmanstown	3	Pepacton	4	Rensselaer	2

New York. (Population, 3,437,202.)

[For comparison with other cities in Class I, see p. 28.]

Herman Betz, M. D., acting chief inspector, division of food inspection.

C. Golderman, secretary pro tem of the department of health.

The daily consumption of milk, as computed in the year 1901, was 333,856 gallons, or an average of 0.78 pint per capita, besides 4,000 gallons of cream. No skimmed milk was used. In reference to this apparently large consumption of milk, the following explanations are offered: There is a floating population in New York City of at least 300,000. About 150,000 persons living in outlying districts spend the business hours in the city; shoppers from neighboring towns and states number about 50,000 per day; there are many public institutions where milk is used largely in the daily diet; persons of some nationalities use much milk on account of its cheapness; and a large amount is taken out of the city by dining cars and vessels.

Milk is sold from about 12,000 stores and 4,000 wagons. About one-sixth of the supply comes to the city in bottles which are filled in creameries and bottling plants in the country, and which are generally shipped in boxes holding 12 quarts each. Probably as much more milk is bottled in the city. Perhaps 5 per cent of the total amount is pasteurized, and this treatment is increasing in favor. The retail price of milk is 6 cents per quart in summer and 8 cents in winter, producers receiving 2½ to

3 cents in summer and 3 to 3½ cents in winter.[a] The milk from a few "model dairies" is sold throughout the year for 12 to 15 cents per quart. There are within the city limits 5,500 "herds," including 23,200 milch cows; 3,500 dairy farms send milk into the city. Eighty-five per cent or more of the total supply is received by rail over a dozen different lines, the longest shipment being 350 miles.

Section 59, and 63 to 67, inclusive, from the sanitary code of laws, govern the sale of milk. In addition to these, regulations and rules have been adopted. No milk shall be received or sold without a permit from the board of health. Permits must be conspicuously posted in stores and carried in wagons, which latter must show wagon number and permit number preceded by the words "Department of health." Unwholesome or adulterated milk; "swill milk;" milk with any added foreign substance; milk from animals kept for the most part in stables, or fed on distillery waste; and milk from diseased cows, from cows within fifteen days before or five days after calving, or from cows kept in a crowded or unhealthy condition, is prohibited, and may be seized and destroyed. The milk standard is 12 per cent solids, 3 per cent fat. Skimmed milk or milk from which any part of its cream has been removed is prohibited. Condensed milk must be made from pure milk, 25 per cent of the milk solids must be fat, and no foreign substance except sugar can be added. Cream must be from pure milk and contain no foreign substance. Milk must not be transferred from cans to other vessels on the streets, or ferries, or in depots, except when "transferred to vessel of purchaser at time of delivery." Vessels in which milk is kept must be covered so as to exclude dust and other impurities. Milk must not be kept for sale, nor bottled in a room used for sleeping or domestic purposes, nor in a room opening into the same. Before use, milk bottles must be washed with a hot-water cleaning solution and then with hot water; they may be filled only at the dairy or creamery or in a room in the city properly protected to prevent contamination from dust. Eight rules published with the ordinance and regulations refer to certain miscellaneous details, such as the storage of the milk, the construction and care of the ice box, the use of ice in milk, etc. In a short circular intended to be sent to milk dealers whenever occasion arises, the health department calls special attention to a few important requirements of the law, principally in reference to adulteration.

[a] The following statistics are taken from the Milk Reporter:

Total number of cans of milk, cream, and condensed milk received in the New York market monthly during 1902, and the average price of milk per quart each month.

1902.	Cans of milk (40 quarts).	Cans cream and condensed milk (40 quarts).	Average price of milk per quart.
			Cents.
January	796,128	29,285	3.38
February	729,723	30,405	3.25
March	835,240	36,009	3.04
April	826,475	38,654	2.87
May	917,438	54,303	2.63
June	924,101	59,020	2.25
July	927,825	57,533	2.25
August	874,488	50,318	2.42
September	852,461	40,368	2.50
October	869,318	35,143	3.00
November	831,766	31,820	3.25
December	821,424	30,849	3.75
1902 Total	10,197,387	493,707	.....
1902 Average	27,938	1,352	2.88
1901 Total	9,757,835	460,334	.....
1901 Average	26,734	1,261	2.62
1900 Total	9,388,947	422,754	.....
1900 Average	25,741	1,156	2.74

Rules and regulations governing the sale of milk are given in full in Appendix I (p. 165).

The amount expended annually in the supervision of the milk supply is included in the general appropriation to the department of health and can not be stated separately. Twelve officials—inspectors, chemists, and assistant chemists—give their entire time to this work. During the last year of record 78,344 specimens of milk were examined; 1,313 samples were collected for analysis; 448 quarts of adulterated milk were destroyed; 560 of the 5,500 city dairy herds were inspected; 6,843 cows were examined; and 127 cows were condemned. Published reports for other recent years show much more work along these lines; for example, the report for 1899 (pp. 63 and 71) contains the following:

Milk inspections.

	Number.
Inspections	51,498
Specimens examined	50,457
Samples of milk	945
Citizens' complaints received	286
Original complaints by inspectors	81
Citizens' complaints returned for orders	37
Citizens' complaints returned as negative	225
Citizens' complaints under observation	2
Days at court or department	2,757
Special day inspections	10,310
Early morning inspections	335
Nights of special work	48
Quarts of adulterated milk destroyed	95
Days in country or at laboratory	559
Arrests	193
Held on bail	185
Discharged	20
Trials at special or general sessions	180
Amount of fines	$4,285

Inspection of cows.

	Number.
Inspections of premises	15,650
Herds examined	461
Cows tagged	2,434
Temperatures taken	22,421
Cows examined (tuberculin test)	2,580
Cows examined (tuberculin test), negative	2,513
Cows found diseased	66
Cows condemned	62
Autopsies	59
Citizens' complaints received	75
Citizens' complaints returned for orders	5
Citizens' complaints returned as negative	68
Citizens' complaints under observation	1
Original complaints by inspectors	3
Days at court or department	957
Nights special work	594
Analyses	5,115
Experimental analyses	764
Lactometers tested	71
Thermometers tested	15
Days at court or department	1,422

The form for application to sell milk and the special-information form for milk sellers are shown in Appendix IV (p. 192).

The forms for milk-store permit and milk-wagon permit are shown in Appendix IV (p. 200).

The department of health has issued two instructive circulars regarding the production of pure milk and the proper manner of handling it. Mention should be made also of the milk commission of the medical society of the county of New York, which has undertaken to increase the supply and demand for high-grade milk. The work of this commission has already shown very satisfactory results. It is referred to at length in an article entitled "Market milk: A plan for its improvement," which was published in the Seventeenth Annual Report of the Bureau of Animal Industry.

The Rockefeller Institute for Medical Research early declared one of its purposes to be attention to matters of public hygiene and a study was made by it, in 1901, of some of the questions relating to the milk supply of New York City. A partial report has been published of the work accomplished. Special attention was paid to the bacteria in the milk supply of the city, with reference to the number and character of these germs at different times and the changes which occur between the milking of the cows and the delivery to consumers. An attempt was made to examine the conditions prevailing at producing farms, but the number visited was so manifestly inadequate and the inspections made were of such a character, judged from the report, that this branch of the investigation was merely suggestive in its result, and somewhat misleading. Much more practical in plan, more efficient in execution, and more effective in result was a systematic investigation of the manner in which infants living in tenement houses in the city were fed upon milk during the hot months. The reporters for the institute concluded that the most hopeful work in improving the milk supply of this city was being done through the milk commission already mentioned and by the efforts of a few milk-supply companies and some enterprising individual dealers.

There has been recent decided improvement in the composition and cleanliness of the milk supply. Needed proposed improvements include regular inspections of farms and dairies, especially at milking time; animals to be kept under more sanitary conditions; stables to be cleaner; milk to be shipped as soon as possible after milking.

Buffalo. (Population, 352,387.)

[For comparison with other cities in Class I, see p. 28.]

Edward Clark, M. D., and William B. May, M. D., milk inspectors.

The daily consumption of milk is estimated as 31,000 gallons, or 0.70 pint per capita. The daily consumption of skimmed milk is estimated as 10,000 gallons. Milk is sold from 1,200 stores and 529 wagons. About one-third of the supply is delivered in glass bottles, and these are filled in the city stores. A limited amount of pasteurized milk is used. It seems to be gaining in favor. The retail price of milk is 6 cents per quart throughout the year, the producers receiving on the farm 2½ and 3 cents, respectively, in the summer and winter seasons. The product of a few dairies in the vicinity of the city which are conducted in an up-to-date manner is sold for 7 cents per quart throughout the year. Within the city limits there are 22 herds of milch cows, including 340 head. Milk is sent into the city from 656 dairy farms.

The city ordinances relating to the supply and distribution of milk are quite lengthy. The sections on this subject, as published by the department of health in 1897, are Nos. 9, 87–97, 100, 237, and 238. A permit must be obtained from the department of health (fee, $1) for keeping cows within the city limits, but no person can keep more than 1 cow unless his "premises are in proportion of 1 acre of land

to each and every cow above the number of 1." No person can bring milk into the city for sale without a written permit from the health department (fee, $3); permit will not be issued until a satisfactory statement showing applicant's residence, number of cows, etc., has been filed. A license from the mayor is required for selling milk; the fee for each vehicle is $2. Licenses and permits must be renewed each May; they are revocable for cause. Retail dealers, grocers, and bakers must display a sign showing from whom their milk is obtained. Milk wagons must show license numbers, etc., and in summer months must be covered. The law prohibits the sale of impure or adulterated milk, including the product of diseased cows and "cows that for the most part are kept tied up in the stables," and cows fed on garbage or other improper food.. The milk standard is 12 per cent solids, 3 per cent fat, 1.029 specific gravity. Skimmed milk may be sold if in a plainly marked vessel and does not contain a less percentage of casein and salts than is contained in whole milk. The construction of milk rooms and milk boxes must conform to prescribed regulations. Milk cans must be cleaned before being returned to the dairy. The removal of milk bottles from a house where a contagious disease exists and the filling of bottles on a delivery wagon are prohibited.

About $2,000 is expended annually in the supervision of the milk supply. Two inspectors give all of their time to this work, and the city chemist a part of his time. During the last year 1,022 samples of milk were examined by lactometer; 64 by Babcock test and gravimetric analysis; bacteriological examination was made of 3 samples; and all of the herds within the city limits were twice inspected. A medical milk commission has exercised considerable influence toward the improvement of the city's milk supply by giving special encouragement to those interested in the production and sale of the highest grade of milk.

Among the recent improvements in the milk supply of the city the following is named: Better sanitary conditions where milk is produced and handled, including the practice of cleaning cans before they are returned to the dairy farms. Needed improvements, as given, include thorough inspection of all dairy farms sending milk into the city, the requirement that milk shall be cooled immediately after milking, refrigerator cars for shipment, and provision to protect milk from the heat when it is standing on the railroad platforms awaiting trains.

Rochester. (Population, 162,608.)

[For comparison with other cities in Class I, see p. 28.]

W. O. Marshall, meat and milk inspector.

Estimated average amount of milk used daily, 17,000 gallons, or 0.83 pint per capita, besides some skimmed milk and cream. The milk is distributed from 75 stores and 275 wagons. There seems to be little interest manifested in pasteurization. The retail price of milk is 5 cents per quart in summer and 6 cents in winter, the producer receiving one-half these amounts; skimmed milk is sold for 2½ cents per quart. The milk of 10 well-conducted dairies in the vicinity is sold for 6 cents per quart in summer and 8 cents in winter. Six herds, including 90 cows, are within the city limits, and milk is sent in from 200 dairy farms. Two-thirds of the total supply is shipped by rail, the farthest distance being 45 miles.

Ordinances Nos. 16, 17, and 18 (date?) refer to the milk supply. A license from the health department is required for the sale of milk, and its number must be shown wherever milk is sold. Its cost is $3 per year, and it is revocable for cause. Special care is required in the selection of persons licensed. Adulterated or unwholesome milk, milk from cows diseased or "confined for the most part" in stables, or fed on swill, brewery grains, distillery waste, or fermented food, or milk from cows fifteen days before or five days after calving, is forbidden. The milk standard is 12 per cent solids, 3 per cent fat. Skimmed milk is allowed if plainly labeled. Within

the built-up portion of the city no one can keep more than 1 cow to a city lot 33 by 150 feet, and in the outlying portions of the city not more than 15 cows for each acre of land, except by special permission of the health department. Stables within the city must be kept clean, be well ventilated, and have 800 cubic feet of air space for each cow; the floor must be well drained; cows must be well bedded and kept clean; and every cow must be allowed to go out doors at least two hours every day.

Ordinance section regulating the number of cows to be kept in the city is given in Appendix I (p. 180).

The city expends annually about $4,000 for the supervision of the milk supply. Two officials—a milk inspector and chemist—give their entire time to this work. They examined during the past year 4,254 samples by lactometer and Babcock test; 204 samples by gravimetric analysis; and 335 samples for bacterial content; and inspected all of the herds in the city, and 175 of the 200 dairy farms. The average butter-fat content of samples examined in 1900 was 3.91 per cent. In a study of the dirt content of milk as shown by the number of bacteria, it was found there were relatively fewer bacteria in summer than in the cold season, the relation being 1:3.5. This is explained by the increased care necessarily given to milk in the warm weather to prevent its souring. In connection with some other work, the numbers of bacteria per cubic centimeter in 24 samples of milk are given; four times they exceeded 5,000,000 and in four samples they were fewer than 100,000, the lowest number being 15,000.

The most marked improvement recently made in the quality of the milk supply is due to increased cleanliness in its production. It is recommended that the use of swill feed be stopped; that milk be mixed so that all cans from one dairy will test alike; and that greater cleanliness be observed.

Syracuse. (Population, 108,374.)

[For comparison with other cities in Class I, see p. 28.]

F. E. Engelhardt, milk inspector and chemist.

The estimated average amount of milk used daily is 10,200 gallons, or 0.75 pint per capita, besides 800 gallons of skimmed milk and 250 gallons of cream. Milk is distributed from 340 stores and 195 wagons. While the practice of using glass bottles has greatly decreased during the past two years, there are yet about 2,500 in daily use, and these are filled on the farms and in one large milk-handling establishment in the city. About 200 gallons of milk is pasteurized daily, and its use is increasing. The retail price of milk is 5 cents per quart, and the producers are paid 2⅞ cents per quart throughout the year. About 40 dairies are said to be conducted in a satisfactory manner. Only 1 of them, however, which guarantees its milk to contain 4.5 per cent of fat, receives more than the market price; its milk is sold for 8 cents. There are 14 dairy herds in the city, including 176 cows; 217 dairies send milk into the city; only about 1 per cent is received by railway, the longest shipment being 8 miles.

Articles VI and XVII, sections 4, 19, and 20, and the special milk laws of the sanitary code of the department of health, 1901, refer to milk. The milk inspector must, twice a year, visit all farms producing milk for sale in the city and inspect cans, water supply, feeds, and the sanitary condition of stables. License fee for the sale of milk is $10(?). Before license is granted, persons sending milk to the city must file a certificate from a competent veterinarian, showing that his cows are free from disease. Impure or adulterated milk; milk from cows within five days after calving; milk from cows fed on unwholesome food, or milk with any added foreign substance, is prohibited. Persons working in a dairy shall not come in contact with persons having a contagious disease. Milk cans on milk wagons, used in retailing skimmed milk, sour milk, buttermilk, or "left" milk, shall be painted reddish brown. Permit must be obtained for the sale of bottled milk. No bottles shall be filled with milk except

at a dairy, and all bottles must be properly sterilized before being again used. An ordinance has been passed requiring that all cows supplying the city with milk be submitted to the tuberculin test. The health officer, in a circular letter dated November 12, 1900, requires special care in the production and handling of milk; cleanly practices which should be observed in dairies are described.

The annual appropriation for the supervision of the city milk supply is $1,400; $300 of this is for laboratory expenses, and $1,100 is for the salary of one officer—the milk inspector and chemist. During the year 1902, 10,630 samples of milk were examined, all by lactometer, and doubtful cases by the Babcock test and gravimetric analysis, 120 analyses being made; 12 milk samples were found to be below the legal standard; 4 cans of milk were condemned and returned to the farms; 19 milk cans, 41 can covers, and 30 dippers were also condemned. All the dairy herds and farms furnishing the city with milk were inspected during the year, and 1 was put under quarantine; 3,410 cows on 200 farms were examined for tuberculosis, use being made of the tuberculin test; 20 were found to be diseased. A recent annual report of the milk inspector shows in detail the amount of work accomplished. It contains, also, much interesting information regarding the ways that milk becomes contaminated, and shows what methods should be followed to insure its purity. Such a report must be of much value in the hands of producers and dealers.

The milk association has done much to improve the supply and distribution of milk in this city. It has made it possible for the milk depots to have on hand at all times properly pasteurized and unpasteurized milk and cream, skimmed milk, buttermilk, cottage cheese, and fresh butter. These products are fresh and clean. Whenever outside peddlers are short of milk they are usually supplied by the association. The details of the work are conducted on hygienic principles.

Recent marked improvements in the milk supply are due to better care of the stables and greater cleanliness in handling milk. The need of rigid restrictions against the use of adulterants and the much-advertised preservatives is emphasized. A competent person should occasionally inspect the dairy farms and impart information as to the best methods of producing and handling milk.

Albany. (Population, 94,151.)

[For comparison with other cities in Class II, see p. 32.]

George L. Flanders, assistant State commissioner of agriculture.

The daily consumption of milk is estimated as 8,022 gallons, or an average of 0.68 pint per capita, besides 1,468 gallons of skimmed milk and 213 gallons of cream. Milk is sold from 105 stores and 188 wagons. Only a small part of the milk supply is delivered in glass bottles, and these are filled in the city. One firm pasteurizes milk, but this practice is not gaining in favor. The retail price of milk is 6 cents per quart throughout the year, producers receiving 3 cents. There are no "model dairies" in the vicinity. Within the city limits there are 25 herds, including from 4 to 40 cows each, or a total of 366 cows, and milk is sent in from 150 dairy farms. One-fourth of the total supply is received by railway, the longest shipment being 62 miles.

Rules and regulations adopted by the health department in March, 1897, supplement the State laws regarding the city milk supply. License for the sale of milk is issued free of charge. Cows must not be watered from wells in barnyards. Hands of milkers and milk utensils must be thoroughly cleaned. Milk shall not be handled by persons exposed to or suffering from a contagious disease. Bottles must not be filled in the street, in cars, at railroad stations, or in any place where dust may get into the milk. Nor can milk be stored or bottled in living rooms, except at the residence of customer.

The supervision of the city milk supply comes under State authority. During

the past year 12,000 samples of milk were examined in the streets by the lactometer, and occasional samples were examined by the Babcock test and by gravimetric analysis; a few bacteriological examinations were made; farms are inspected when there is special cause showing that this is necessary.

The establishment of a milk commission is under consideration by the county medical society. The object of such a commission would be the encouragement of the production of pure milk. A member of the committee of the medical society inquiring into this subject is quoted as saying: "This is being done for our own protection, as we doctors are frequently asked what milk dealers we would recommend, and, without data of our own, our recommendation can be little more than a suggestion. It is the design of this committee to ascertain who sells the best milk and have that used by the families where we are called. In this way we believe the public will soon find out where the best milk can be obtained, and there will then be a general demand for it." The committee will point out to dairymen what improvements can be made and encourage such improvements.

Troy and Lansingburg. (Population, 73,246.)

[For comparison with other cities in Class II, see p. 32.]

The daily consumption of milk is estimated as 6,000 gallons, or an average of 0.66 pint per capita, besides 750 gallons of skimmed milk. Milk is sold from nearly all of the small grocery stores and also from 120 wagons. About 15 per cent of the retail trade is supplied in glass bottles, filled in the city. About 12 per cent of the milk is pasteurized, and this treatment is increasing in favor. The retail price of milk is 6 cents per quart throughout the year, the producer receiving 2¾ cents in summer and 3½ cents in winter. There are no "model dairies" near the city. Milk is received from 200 dairy farms, 12 per cent coming by railway, the longest shipment being 50 miles.

State authorities supervise the milk supply. The need is felt of a closer examination of cows, farms, and water supply.

Utica. (Population, 56,383.)

[For comparison with other cities in Class II, see p. 32.]

Wallace Clarke, health officer.

George C. Hodges, chemist, New Hartford.

The daily consumption of milk is estimated as 5,000 gallons, or an average of 0.71 pint per capita, besides 300 gallons of skimmed milk and 150 gallons of cream. Milk is sold from 60 stores and 210 wagons. About one-fourth of the total supply is delivered in glass bottles, which are filled at the producing farms. No milk is pasteurized. The retail price of milk is 5 cents per quart in summer and 6 cents in winter, producers receiving 2 and 2½ cents summer and winter, respectively. There are 2 or 3 especially well-conducted dairies near the city, but their milk is not sold for an extra price. There are 5 herds, including 50 cows, within the city limits, and milk is brought to the city in wagons, from 125 dairy farms, the longest haul being 10 miles.

Board of health regulations Nos. 18, 19, 20, and 50 refer to milk. Persons selling milk must register with the city clerk. Adulterated, etc., milk or cream is prohibited. Milk cans in delivery wagons must be protected from the sun. Bottles must be filled only at the dairy or place of general supply. The milk standard is 12 per cent solids, 3 per cent fat. Regulation No. 50, consisting of 21 rules for the conduct of dairies, is printed on a heavy cardboard and must be posted in the barn, dairy, and place of business of each person selling milk or cream. Persons exposed to or suffering from a contagious disease must not handle the milk supply. Rooms where

milk is kept must be properly located. Skimmed milk must be in a can or receptacle painted a distinct blue color.

About $600 is expended annually in the supervision of the milk supply, one inspector giving his entire time to this work. During the past year 50 samples of milk were examined by lactometer and Babcock test, suspected ones by gravimetric analysis; one bacteriological examination was made; all the city herds and all the dairy farms were inspected.

Yonkers. (Population, 47,931.)

[For comparison with other cities in Class III, see p. 36.]

Clark A. Sloan, milk inspector.

The daily consumption of milk is estimated as 4,000 gallons, or 0.67 pint per capita, besides 40 gallons of cream. No skimmed milk is sold. Milk is delivered from 208 stores and 56 wagons. About one-third of the milk retailed from wagons is delivered in glass bottles, filled mostly in the city. One firm pasteurized about 250 quarts daily during June, July, August, and September. The retail price of milk is 5 to 7 cents per quart in summer and 6 to 7 cents in winter, producers receiving 2½ to 3 cents in summer and 3 to 4 cents in winter. The milk from 3 "model dairies" near the city is sold for 8 to 10 cents per quart throughout the year. Within the city limits there are 28 herds, including 648 cows, and milk is sent in from 54 dairy farms. About one-half of the milk is received by railway, the longest shipment being 85 miles.

Board of health regulations, sections 48 to 61, and an amendment passed in April, 1900, refer to milk. Licenses for the sale of milk are granted free of charge. Adulterated, impure, etc., milk is prohibited. Brewers' grains may be fed if fresh. Bottled milk must not be delivered where there is a contagious disease, and bottles must be washed before being refilled. The milk standard is 12 per cent solids, 3 per cent fat. Skimmed milk must be labeled.

There is expended annually $2,500 in the supervision of the milk supply. One inspector, chemist, and bacteriologist gives his entire time to this work, and a veterinary inspector part of his time. During the past year 123 milk samples were analyzed gravimetrically; 43 were examined bacteriologically for puss cells and bacterial content; all the city herds and 6 of the 54 dairy farms were inspected.

The form for prohibiting and permitting the use of bottles is shown in Appendix IV (p. 209).

There has been a marked improvement in the character of the milk supply, due to an increase in the amount of milk delivered in bottles, and better sanitary conditions at dairy premises. It is proposed that stores be compelled to handle only bottled milk.

Binghamton. (Population, 39,647.)

[For comparison with other cities in Class III, see p. 36.]

William H. Abbott, secretary of the health department.

The daily consumption of milk is estimated as 2,520 gallons, or 0.51 pint per capita, besides 215 gallons of skimmed milk and 250 gallons of cream. Milk is sold from about 50 stores and 72 wagons. Fifty per cent of the milk is delivered in glass bottles, some filled at the farms and some in the city, and about 50 per cent is pasteurized, the practice increasing. The retail price of milk is 5 cents per quart throughout the year, the producers receiving 2 cents or less per quart in the summer season. The milk from a few specially well-conducted dairies is sold for 5 to 6 cents per quart. There are no dairy herds within the city limits. A small part of the milk from the dairy farms within a radius of 10 miles is brought to the city by trolley cars.

Ordinances prohibit the sale of impure milk.

There is no milk inspector and nothing is expended by the city in the supervision of its milk supply. The board of health takes action when complaints are received. During the past year certain individuals made bacteriological examinations of 6 samples of milk.

Elmira. (Population, 35,672.)

[For comparison with other cities in Class III, see p. 36.]

Jacob Miller, city meat and milk inspector.

The daily consumption of milk is estimated as 5,000 gallons, or 1.12 pints per capita. Milk is sold from 25 stores and 100 wagons. Glass bottles, some filled at the farms and some in the city, are used largely in the delivery of milk. The retail price of milk is 5 cents per quart throughout the year, producers receiving 2½ cents and 3 cents in the two seasons. Four dairies are conducted in an especially satisfactory manner, but their milk is not sold for an advanced price. Within the city limits there are 8 herds, including 170 cows, and milk is sent in from 150 dairy farms within 6 miles of the city.

One official gives a part of his time to the supervision of the milk supply. During the past year all of the dairies sending milk into the city were inspected; a number of milk samples were examined by lactometer; none were examined bacteriologically.

It is stated that dairies should be kept in a more sanitary condition, and more care should be taken as to the cleanliness of milk vessels.

A milk commission has recently been established for the purpose of encouraging the production and use of pure milk.

Schenectady. (Population, 31,682.)

[For comparison with other cities in Class III, see p. 36.]

William T. Clute, health officer.

The daily consumption of milk is estimated as 2,000 gallons, or 0.51 pint per capita. Milk is sold from 8 stores and 34 wagons. A small portion is delivered in glass bottles, some filled in the city and some at the farms. No milk is pasteurized; this treatment was tried but discontinued. The retail price is 5 cents per quart in summer and 6 cents in winter, producers receiving 2½ and 3 cents in the two seasons. There are no "model dairies" near the city. Within the city limits there are 3 herds, including 20 cows. About 260 gallons of milk is received daily by railway, the longest shipment being 18 miles.

Only a small amount is expended by the city in the supervision of the milk supply. During the past year 500 samples of milk were examined by the lactometer; no bacteriological examinations were made; none of the city herds or dairy farms were inspected.

There has been a recent improvement in the composition of the milk supply. The inspector recommends that the sanitary conditions of dairies be placed under the supervision of the board of health.

Auburn. (Population, 30,345.)

[For comparison with other cities in Class III, see p. 36.]

R. A. Dyer, acting milk inspector.

The daily consumption of milk is estimated as 3,000 gallons, or 0.79 pint per capita, besides 50 gallons of skimmed milk and 50 gallons of cream. Milk is sold from 4 stores and 60 wagons, and about 10 per cent of it is delivered in glass bottles, which are filled at the farms. Sixty gallons of milk is pasteurized daily, and the milk thus

treated is increasing in favor. The retail price is 5 cents per quart throughout the year, the producers receiving 2½ cents. Within the city limits there are 5 herds, including 230 cows, and milk is sent in from 50 dairy farms, all within a radius of 6 miles.

City ordinances regulate the milk supply. The milk inspector must inspect all places where milk is produced or sold. Cow stables must be well constructed, kept clean, and cows must be given pure water. Adulterated, etc., milk and milk produced or handled where there is a contagious disease is prohibited.

During the past year 450 samples of milk were examined for cream volume, and 160 by the Babcock test; no bacteriological examinations were made. In 1899, 421 cream tests were made, showing an average of 17.5 per cent of cream by volume; 204 fat tests were made by the Babcock machine with an average of 4.2 per cent fat; 18 of the 50 dairy farms were visited.

The inspector suggests that the milk supply might be improved if dairy farms were inspected under the direction of the State department of agriculture, which has facilities for making bacteriological as well as chemical examinations of milk.

Watertown. (Population, 21,696.)

[For comparison with other cities in Class IV, see p. 40.]

Thomas Burns, veterinary surgeon.

The daily consumption of milk is estimated as 2,400 gallons, or 0.88 pint per capita, besides 750 gallons of skimmed milk and 150 gallons of cream. Milk is sold from 15 stores and 40 wagons. Seven per cent of it is delivered in glass bottles, filled both in the city and at the farms. A small quantity is pasteurized, and the practice is increasing. The retail price of milk is 5 cents per quart throughout the year, producers receiving 2½ cents. Within the city there are "14 herds, including 18 cows," and milk is brought in wagons from 37 dairy farms, the longest haul being 7 miles.

There is expended annually $750 in the supervision of the milk supply, two officials giving a part of their time to this work. During the past year 850 samples were examined by lactometer, Babcock test, and gravimetric analysis. No bacteriological examinations were made. All the city herds and all the dairy farms were inspected. An effort is being made to induce all dairymen to adopt the tuberculin test.

Recent improvement in the supply is due to better dairy rations and better methods for the care and delivery of milk.

Mount Vernon. (Population, 21,228.)

[For comparison with other cities in Class IV, see p. 40.]

N. Eugene Smith, M. D., health officer.

The daily consumption of milk is estimated as 3,000 gallons, or 1.18 pints per capita, besides 350 gallons of cream. In explanation of the large consumption of milk, it is stated that large amounts are used in institutions the inmates of which are not numbered in the population of the city. No skimmed milk is sold. Milk is sold from 15 stores and 60 wagons. Nearly one-third of it is delivered in glass bottles, and these are filled at the receiving stations and by local dealers. A small amount is pasteurized, and this practice is increasing. The retail price is 7 to 15 cents per quart in summer, and 8 to 15 cents in winter, producers receiving 1¼ to 2 cents in summer and 3 cents in winter. The milk from 4 "model dairies" is sold for 8 to 15 cents per quart throughout the year. Within the city limits there are 10 herds, including 100 cows, and milk is sent in from 90 dairy farms. One-third of the total supply is received by railway, the longest shipment being 75 miles.

The sanitary code of health, 1893, sections 86 to 96, refer to milk. License fee for the sale of milk is $1. Adulterated, etc., milk is prohibited. The milk standard is

12 per cent solids, 3 per cent fat, and specific gravity not less than 1.029. Cans and wagons from which skimmed milk is sold must be labeled. Milk-delivery wagons must be covered during the months of June, July, and August. Cows must not be fed on garbage, swill, etc. Stores must post in a conspicuous place the names of persons furnishing milk.

There is expended annually $500 in the supervision of the milk supply. During the past year 40 samples of milk were examined by lactometer, Babcock test, and gravimetric analysis; 275 bacteriological examinations were made for typhoid bacilli, etc.; all the city herds and all the dairy farms were inspected.

Recently there has been an improvement in the quality of the milk supply. Further improvement would result if inspections were more frequent and if licenses were revoked wherever the milk is not being properly produced or handled.

Lockport. (Population, 16,581.)

[For comparison with other cities in Class IV, see p. 40.]

C. A. Warren, agent of the New York State department of agriculture.

The daily consumption of milk is estimated as 900 gallons, or an average of 0.43 pint per capita, besides 25 gallons of skimmed milk and 20 gallons of cream. Milk is sold from 30 stores and 24 wagons. About 10 per cent of it is delivered in glass bottles filled both in the city and at the farms; none is pasteurized. The retail price is 5 cents per quart in summer and 6 cents in winter, producers receiving 2½ cents and 3 cents in the two seasons. There are no "model dairies" near the city. Within the city limits there are 2 herds, including 14 cows, and milk is brought in wagons from 22 dairy farms, the longest haul being 6 miles.

An ordinance adopted January, 1887, refers to milk. License fee for the sale of milk is $1 to $10 for each person selling from wagons, the amount in each case to be fixed by the mayor, and $1 for each person selling from a store or shop or peddling it in a small way.

The milk supply is under the supervision of State authorities, the city appropriating nothing for this work. During the past year about 1,000 samples of milk were examined by lactometer; 40 samples by the Babcock test; no bacteriological examinations were made; the city herds and 12 of the 22 dairy farms were inspected.

Rome. (Population, 15,343.)

[For comparison with other cities in Class IV, see p. 40.]

J. M. Currie, V. S., meat and milk inspector.

The daily consumption of milk is estimated as 1,000 gallons, or 0.52 pint per capita. Milk is sold from 4 stores and 26 wagons. About one-fourth of it is delivered in glass bottles, filled usually at the farms; none is pasteurized. The retail price is 4 cents per quart in summer and 5 cents in winter, producers receiving 2 cents and 2½ cents in the two seasons. There are no "model dairies" near the city. Within the city limits there are 3 herds, including 65 cows, and milk is sent in from 36 dairy farms within a radius of 6 miles.

The meat and milk inspector (salary $800) gives about one-half of his time to the supervision of the milk supply. During the past year 106 samples were examined by lactometer and Babcock test. All the city herds and dairy farms were inspected.

Recent improvement is due to cleaner barns, better cattle foods, and more sanitary methods of milking. It is recommended that milk dealers be required to obtain licenses, and that coupon tickets employed in making regular retail sales be destroyed after being used once.

NORTH CAROLINA.

Public laws of 1899, chapter 86, refers to foods. It is unlawful to sell adulterated food, which is defined at length. The board of agriculture shall examine samples of food and may publish results. Solicitors shall prosecute for violations reported by the commissioner of agriculture.

NORTH DAKOTA.

E. E. Kaufman, assistant dairy and food commissioner, Fargo.

Laws of 1899, chapter 72, refers to milk. The enforcement of this law is charged to the assistant State dairy and food commissioner. Persons selling from vehicles milk from more than 4 cows in any city or town of 1,000 or more inhabitants must obtain license from the assistant commissioner. License fee is $1 annually, and all licenses expire in June. Certain information must be furnished, and changes of employees must be reported. Vehicles shall be marked with license number and name and place of business of owner. License is necessary also for selling milk from a store or stand; fee $1. It is unlawful to sell milk that is adulterated, unwholesome, etc.; milk from an animal diseased or having ulcers, etc.; milk from a cow within fifteen days before and five days after parturition; milk from cows kept in an unhealthy manner, or cream from any such milk. Skimmed milk shall be sold only for what it is. The milk standard is 12 per cent solids, 3 per cent fat; the cream standard is 15 per cent fat.

In the year 1900 the assistant dairy commissioner issued 35 licenses for the sale of milk in 9 cities and towns. Funds not being available, no systematic inspection was made, and as no complaints were received no samples of milk were taken for examination. The dairies supplying milk to three or four cities were inspected. In cities where licenses have been taken out, it is estimated that 650 cows supply milk to 1,950 private families, 40 hotels, 30 restaurants and lunch counters, 30 boarding houses, and 20 soda fountains; the average amount of milk required per month is 25,000 gallons, cream 50 gallons, and skimmed milk 1,900 gallons.

The form for report upon inspection of dairies and herds is shown in Appendix IV (p. 196).

OHIO.

Joseph E. Blackburn, State dairy and food commissioner, Columbus.

Ohio Laws of 1889, volume 86, page 229; and 1886, volume 83, page 120, amended, and page 178, sections 9 to 13, refer to milk, etc. The enforcement of laws relating to foods and drinks is charged to the State dairy and food commissioner. It is unlawful to sell milk to which water or any foreign substance has been added, or milk from diseased cows. The milk standard is 12 per cent solids, 3 per cent fat, except in May and June, when it is 11½ per cent solids. Skimmed milk may be sold from cans plainly labeled. Cows producing market milk shall not be kept in a cramped or unhealthy condition or fed upon food that will produce unwholesome milk. Condensed milk shall be made from pure unskimmed milk, and be plainly labeled, etc.

Ohio Laws of 1884—volume 81, page 67, amended, refers to foods. It forbids the sale of any food that is adulterated, which term is defined at length.

The annual report of the dairy and food commissioner shows that during the past year 22 samples of milk were examined under his direction; 11 of these were from Canton and the remainder from 8 other towns. Only 3 of the samples contained more than 12 per cent total solids, most of them being badly adulterated.

Cleveland. (Population, 381,768.)

[For comparison with other cities in Class I, see p. 28.]

Charles H. Stone, jr., inspector of food.

The average daily consumption of milk is estimated as 21,490 gallons, or 0.45 pint per capita, besides 1,000 gallons of skimmed milk and 500 gallons of cream. Milk is sold from 1,200 stores and 580 wagons. About one-third the total supply is delivered in glass bottles, and these are filled in the city. Very little milk is pasteurized, but there seems to be a growing demand for it. The retail price of milk is 5 cents per quart in summer and 6 cents in winter. There are 2 well-conducted dairies near the city which sell their product for 6 cents per quart in summer and 7 cents in the winter. Within the city limits there are 31 dairy herds, including 225 cows. Milk is sent in from 650 dairy farms, the longest shipment being 65 miles.

There is no reference to a milk ordinance in the special report of the food inspector upon the city milk supply.

The city expends in the supervision of its food supply about $3,000 annually, one food inspector, two assistants, and one sanitary officer giving their entire time to this work. It is impossible to state what portion of the expenditure is in the interest of the milk supply. During the year 6,666 samples of milk were examined by the Babcock test; 300 samples for pathogenic bacteria; and all the city milch cows and 250 of the 650 dairy farms were inspected.

Recent improvements are due to better stabling facilities for milch cows and to more careful handling of the milk. A better knowledge of the care of milk is needed alike by the producer, peddler, and consumer.

Cincinnati. (Population, 325,902.)

[For comparison with other cities in Class I, see p. 28.]

J. Stewart Hagen, M. D., milk inspector.

The daily consumption of milk is estimated as 25,000 gallons, or 0.61 pint per capita. It is said that about half of the milk supply of the city is controlled by one large concern. Milk is sold from about 200 stores and 200 wagons. Glass jars are used only by 3 or 4 milk dealers; they are filled in the city. Milk is pasteurized by two or three concerns and the practice is increasing. The retail price of milk throughout the year is 6 cents per quart, producers being paid half as much. The product of 3 especially well-conducted dairies near the city is sold for 8 cents per quart. Within the city limits there are about 40 dairy herds, including 1,400 head. About 200 dairy farms send milk into the city. Appoximately 25 per cent of the milk supply is shipped by railway, the most distant point of supply being 100 miles away.

No milk ordinance for Cincinnati has been seen, but the milk inspector reports the milk standard to be 12 per cent solids, 3.1 per cent fat.

The annual expenditure for the supervision of the city milk supply is about $1,200. One officer, as dairy and milk inspector, devotes his entire time to the duties of the office. During the year 600 samples were examined by the Babcock test; no bacteriological examinations were made; all the herds in the city and 150 of the 200 dairy farms were inspected.

The milk supply has recently shown a little improvement on account of the increase of the portion that is produced in the country. There should be a rigid inspection for milk containing preservatives, and dairies within the city should be moved to districts where pasturage is available.

Toledo. (Population, 131,822.)

[For comparison with other cities in Class I, see p. 28.]

William H. Schurtz, meat and milk inspector.

The daily consumption of milk is estimated as 9,650 gallons, or 0.59 pint per capita. Milk is sold from 221 stores and 253 wagons. Glass bottles are used in the delivery of milk, some of them being filled in the country and others in the city. The practice of pasteurizing milk is new and is increasing rapidly. The retail price of milk is 5 cents per quart in summer and 6 cents in winter, and the producer on the farm realizes 3 cents per quart in summer and 4 cents in winter. There is 1 so-called "model dairy" in this locality, whose product sells at 8 cents per quart in summer and 10 cents in winter. Within the city there are 41 dairy herds, including 769 cows, and milk is sent into the city from 202 dairy farms. About one-third of the total milk supply is received by railway, the longest shipment being 80 miles.

An ordinance of 26 sections, passed in November, 1900, regulates the sale of milk and cream. A permit to sell milk or cream must be obtained from the board of police commissioners. One dollar must be paid for each conveyance, and each must show permit number and name of dealer. Permits expire the first of the year and are revocable for cause. When application for one is made, certain information regarding the source of the milk supply, wagons to be used in delivery, etc., must be filed. Permit will not be issued until authorities are satisfied, after inspection, with the sanitary conditions of the producing dairies, but while the matter is being considered the applicant may carry on his business. The milk inspector must examine for tuberculosis and other diseases all cows supplying milk for city trade which are in Lucas County, those outside of the county to be examined by some local persons acceptable to the board of health. The tuberculin test may be used. All animals shall be tagged to show results of their examination. Dairy premises must be kept reasonably clean. Names of dairymen supplying milk must be posted in stores. The milk standard is 12 per cent solids, 3 per cent fat, except in May and June, when it is 11½ per cent solids. Skimmed milk may be sold if in vessels plainly labeled and from delivery wagons properly marked. The use of preservatives is prohibited. Filthy milk, milk or cream from diseased cows or cows fed on slops, milk produced in a place where a contagious disease exists, or handled by a person recently so exposed, is prohibited, and may be confiscated if offered for sale.

About $1,250 is expended annually in the supervision of the city milk supply, and one inspector gives his entire time to this work. During the year 450 samples of milk were examined by gravimetric analysis; there were 43 prosecutions and 42 convictions of persons selling milk and cream adulterated by preservatives and otherwise; 14 bacteriological examinations were made of milk from cows having tuberculosis, actinomycosis, and cow pox; all of the herds within the city and 131 of the 202 dairy farms sending milk into the city were inspected. In the preceding year 106 dairies were inspected and 293 of the 2,914 cows were found to be unfit for producing milk.

There has recently been a decrease in the sale of adulterated, skimmed, or preserved milk. Government inspectors should have supervision of dairies producing market milk.

The application for permit to sell milk, upon the back of which the milk ordinance is printed, calls for the following information: Name of applicant and residence; location of dairy or dairies from which applicant obtains his milk and name of owner of such dairy or dairies; number of cows in dairy from which applicant obtains his milk; manner of disposing of milk.

Columbus. (Population, 125,560.)

[For comparison with other cities in Class I, see p. 28.]

W. D. Deuschle, M. D., superintendent of the division of health.

The daily consumption of milk is estimated as 6,397 gallons, or 0.41 pint per capita. The amounts of skimmed milk and cream are not known. Milk is sold from 134 stores and 286 wagons. Glass bottles filled at the producing farms are used quite extensively in the delivery of milk. The practice of pasteurizing is just beginning and is growing in favor. The retail price of milk is 6 cents and the wholesale 4 cents per quart throughout the year. There are several dairies near the city conducted on a better plan than others, but their milk is not sold at an extra price. There are only a few milch cows kept within the city limits, the greater part of the milk supply coming from 191 dairy farms. Only a small portion of the milk supply is shipped into the city by rail, the longest shipment being 40 miles.

Sections 109, 114–118, 120 (amended), and 133 of ordinance No. 6169 refer to the milk supply. A permit to sell milk must be obtained from the board of health. It is issued free and on condition that only pure milk will be handled. Permit number and location of dairy must be shown on wagons, and names of dairymen supplying milk must be posted in stores. The sale of adulterated milk—milk from diseased cows or cows fed upon swill, etc.—is prohibited. The milk standard is 12 per cent solids, 3 per cent fat, except in May and June, when it is 11 per cent solids, 2.5 per cent fat. Milk below the standard, including skimmed milk, may be sold if plainly marked. Cows in the city must be kept in buildings having good floors, and from April to September they must not be confined any other time than from 6 p. m. to 6 a. m. City cow stables must be thoroughly cleaned daily from April to October, and twice a week from November to March, and stables yards must be kept clean.

About $1,200 is expended annually in the supervision of the milk supply. One milk inspector and one bacteriologist give their entire time to this work. During the past year 456 samples of milk were examined by lactometer and the Babcock test, and a few examinations were made for typhoid and tubercle bacilli. No inspection of the few herds in the city or of the dairy farms is reported. (Seventy-eight herds were inspected the year previous.)

Recent marked improvements have been shown in the purity and quality of the milk. Suggested improvements include the inspection by a competent veterinarian of all herds for tuberculosis, the licensing of all milk dealers, the more frequent sanitary inspection of dairies, and more chemical and bacteriological examinations of milk.

Dayton. (Population, 85,333.)

[For comparison with other cities in Class II, see p. 32.]

Nelson Emmons, sr., clerk of the board of health.

The daily consumption of milk is estimated as 6,500 gallons, or an average of 0.61 pint per capita, besides 200 gallons of skimmed milk and 150 gallons of cream. Milk is sold from about 300 stores and 100 wagons. A large amount of the milk supply is delivered in glass bottles which are filled at the farms. Little or no milk is pasteurized. The retail price is 5 to 6 cents per quart throughout the year, the producers receiving 3¾ cents. The milk from 3 especially well-conducted dairies near the city is sold for 7 cents per quart. There are 194 milch cows, in 15 herds, within the city limits. Fifty dairy farms send in milk; about one-half is received by railway (steam and electric), the longest shipment being 20 miles.

The city has no milk ordinance.

No appropriation is made by the city for the supervision of its milk supply. The sanitary police and meat inspector has given a part of his time to the work. During

the past year 5 milk samples were examined for preservatives; all the city herds and 37 of the 50 dairy farms were inspected.

It is proposed that the city should have a veterinary surgeon as a dairy inspector, and an ordinance requiring milk dealers to be licensed.

Youngstown. (Population, 44,885.)

[For comparison with other cities in Class III, see p. 36.]

W. A. Banks, food inspector.

Estimated daily consumption of milk is 2,000 gallons, or 0.36 pint per capita. Milk is sold from 45 stores and 60 wagons. Two-thirds of it is delivered in glass bottles filled at the producing farms. A small quantity of milk is pasteurized; this practice is increasing. Milk is retailed at 6 cents per quart in summer and 8 cents in winter, producers receiving 3 and 4 cents in the two seasons. There are a few specially well-conducted dairies near the city, but they do not receive an extra price for their milk. There are no dairy herds within the city limits. Forty dairy farms send in milk. Only a small portion is received by railway, the longest shipment being 15 miles.

About $100 is expended annually in the supervision of the milk supply, the food inspector giving a part of his time to this work. During the past year 109 samples of milk were examined by the centrifugal method; 12 bacteriological examinations were made; no farms were inspected. It is said that formaldehyde is used extensively during the hot weather to prevent souring.

A needed improvement is the licensing of all milk dealers.

Akron. (Population, 42,728.)

[For comparison with other cities in Class III, see p. 36.]

M. W. Hoye, milk inspector.

The daily consumption of milk is estimated as 3,000 gallons, or 0.56 pint per capita, besides 100 gallons of cream. Milk is sold from 75 stores and 88 wagons. One-sixth of the total supply is delivered in glass bottles, most of which are filled at the farms. No milk is pasteurized. Milk is retailed at 5 cents per quart in summer and 6 cents in winter. There are no "model dairies" near the city. Within the city limits there are 2 herds, including 25 cows, and milk is sent in from 60 dairy farms. Four hundred gallons of milk is received by railway daily, the longest shipment being 20 miles.

There is expended annually $300 in the supervision of the milk supply, one official giving a part of his time to this work. During the past year 580 samples were examined by lactometer and lactoscope; no bacteriological examinations were made; the city herds and 54 of the 60 dairy farms were inspected.

Springfield. (Population, 38,253.)

[For comparison with other cities in Class III, see p. 36.]

Henry H. Seys, M. D., health officer.

This city has no milk ordinance, and there is no inspection of the milk supply. Milk is sold for 5 to 6 cents per quart throughout the year. Two dairies, better conducted than others, receive 6 cents per quart for their product. The longest distance milk is sent to the city is 8 miles.

Canton. (Population, 30,667.)

[For comparison with other cities in Class III, see p. 36.]

James Sell, milk inspector.

The daily consumption of milk is estimated as 2,000 gallons, or 0.52 pint per capita. Milk is sold from 70 wagons. About 10 per cent of the milk is delivered in glass

bottles, filled mostly at the farms. One firm pasteurizes milk, and the practice is increasing very slowly. The retail price of milk is 5 cents per quart throughout the year, producers receiving 3 cents. Within the city limits there are 3 herds, including 41 cows, and milk is sent in from dairy farms within a radius of 10 miles.

State laws supplemented by board of health rules govern the sale of milk. Persons selling milk must have a permit.

There is expended annually $700 by the city in the supervision of its milk supply, two officials—a food and dairy inspector and a milk inspector—giving a part of their time to this work. During the past year milk samples were examined by the lactometer. The city herds and all the dairy farms were inspected.

Hamilton. (Population, 23,914.)

[For comparison with other cities in Class IV, see p. 42.]

A. L. Smedley, M. D., health officer.

The daily consumption of milk is estimated as 1,027 gallons, or 0.34 pint per capita. Milk is sold from 46 stores and 32 wagons. About 3.5 per cent is delivered in glass bottles, half of these being filled at the farms, the rest in the city. About 5 per cent of the total supply is pasteurized; the practice is not increasing. The retail price is 6 cents per quart throughout the year. There are no "model dairies" near the city. Within the city there are 21 herds, including 73 cows, and milk is brought in wagons from 26 dairy farms, the longest haul being 6 miles.

The health department, with an appropriation of $1,500 for all its work, has supervision over the milk supply. During the past year 162 samples of milk were examined by the lactometer and Babcock test, and by chemical tests for preservatives; two examinations were made for tubercle bacilli; 13 city herds and 16 of the 26 dairy farms were inspected.

Recent improvement in the milk supply is due to the decreased use of preservatives. It is recommended that the sale of milk in butcher shops be prohibited; that milk in grocery stores be kept in separate refrigerating boxes; and that no cows be kept within the city limits.

Warren. (Population, 8,529.)

[For comparison with other cities in Class IV, see pp. 42.]

Thomas B. Webb, sanitary policeman and food inspector.

The daily consumption of milk is estimated as 645 gallons, or 0.60 pint per capita, besides 20 gallons of skimmed milk and 20 gallons of cream. Milk is sold from 1 store and 11 wagons. About 30 per cent of the milk is delivered in glass bottles, half of these being filled in the city and the rest at the farms; none is pasteurized. The retail price is 5 cents per quart throughout the year, producers receiving 2½ to 3 cents in summer and 3 cents in winter. The milk from 5 dairies, conducted in a better manner than others, is sold at the regular price. Within the city limits there is 1 herd (24 cows), and milk is received from 16 dairy farms. In summer about 3 per cent is shipped by railway, the longest shipment being 15 miles.

Secs. Nos. 66 to 72 of the sanitary code of January, 1896, refer to milk. Milk license fee is 50 cents, but persons having only 1 cow are exempt. Impure, adulterated, etc., milk is prohibited. Skimmed milk must be labeled. Milk must be from cows inspected and found to be healthy.

Nothing is appropriated by the city for the supervision of its milk supply. The dairies pay for the inspection. During the past year 123 samples of milk were examined by the Babcock test; 2 samples were tested for preservatives; no bacteriological examinations were made; the city herd and the dairy farms were inspected.

Recent improvement is due to better food and water supply of dairies, ventilation, and cleanliness of stables, the semiannual inspection of dairies, and the publication in the daily papers of the monthly fat tests.

Fostoria. (Population, 7,730.)

[For comparison with other cities in Class IV, see p. 42.]

E. A. Schubert, milk inspector.

The daily consumption of milk is estimated as 400 gallons, or 0.41 pint per capita, besides 25 gallons of skimmed milk and 10 gallons of cream. Milk is sold from 10 stores and 8 wagons. A small portion of it is delivered in glass bottles, and these are filled at the farms. Some milk is pasteurized, and the practice is increasing. The retail price is 5 cents per quart in summer and 6 cents in winter, producers receiving 3 and 3½ cents in the two seasons. The milk from 2 well-conducted dairies is sold for 6 cents in summer and 7 cents in winter. Within the city limits there is "1 herd, including 125 cows," and milk is brought in wagons from 6 dairy farms, the longest haul being 3 miles.

There is expended annually $200 in the supervision of the milk supply, one official giving a part of his time to this work. During the past year 108 samples were examined by lactometer, Babcock test, and gravimetric analysis; 3 bacteriological examinations were made; all the city cows and all the dairy farms were inspected.

Recent improvement in the milk supply is due to better feed and to the introduction of a better grade of cattle.

OKLAHOMA.

Compiled statutes of 1893, chapter 25, article 36, section 16, and article 50, sections 1, 2, and 8, and chapter 8, section 4, refer to milk, foods, etc. The board of health shall destroy any impure article of food offered for sale. Milk from a "cow not in proper condition of health," or any milk adulterated by water or a deleterious substance, or colored, shall not be sold or delivered. The adulteration of food or drink with fraudulent intent is a misdemeanor. The buyer shall be informed if provisions are diseased or unwholesome.

OREGON.

J. W. Bailey, State dairy and food commissioner, Portland.

An act approved February 27, 1901, refers to milk, foods, etc., and its enforcement is charged to the State dairy and food commissioner. The chemist of the State agricultural college shall assist by making analyses. Justices' courts have concurrent jurisdiction. The dairy and food commissioner shall inspect dairy herds, methods of feeding, etc., as often as possible. The dairy and food commissioner shall keep a list of all persons selling milk or cream in cities of 10,000 or more inhabitants. Such persons shall secure from the commissioner a metal plate giving name, etc., for attachment to each wagon, and shall report changes of management or location. The State veterinarian shall be notified of diseased cows. Owners must give proper attention to dairies found in a filthy or unhealthy condition, when so directed by the commissioner. Milch cows in stables shall be allowed 800 cubic feet of air space each; when facing each other, shall not be closer than 10 feet. Stables shall be well ventilated and kept in a healthful condition. It is unlawful to sell any unclean, diseased, or unwholesome food or drink. The sale of milk from cows within fifteen days before and five days after parturition, or from cows fed on unwholesome food, is forbidden. The use of certain preservatives in milk or cream is prohibited. No adulterated food or drink shall be sold unless plainly marked to show its true character. Such articles are defined in detail, and include milk having less than 12 per cent solids or 3 per cent fat or 9 per cent solids not fat, or showing less than 1.038 specific gravity after the removal of the cream. Manure must not be allowed to accumulate within 150 feet of any barn where dairy cows are stabled.

Portland. (Population, 90,426.)

[For comparison with other cities in Class II, see p. 32.]

J. W. Bailey, State dairy and food commissioner.

The daily consumption of milk is estimated as 7,500 gallons, or an average of 0.66 pint per capita. Milk is sold from 25 stores and 150 wagons. Only a very small portion of the milk supply is delivered in bottles, and these are filled in the city. Little or no milk is pasteurized. The retail price is 5 cents per quart in summer and 5 to 7½ cents in winter, producers receiving 2½ cents in summer and 2½ to 3 cents in winter. There are no "model dairies" near the city. Within the city limits there are 45 herds, including 240 cows, and milk is brought in wagons from dairy farms within a radius of 8 miles.

The city has no milk ordinance, the milk supply being regulated by State laws.

The city makes no appropriation for the supervision of its milk supply. The little work accomplished along this line is done by the State dairy and food commission. During the past year 75 milk samples were examined by the Babcock test and by gravimetric analysis; no bacteriological examinations were made; 20 of the 45 city herds and 15 dairy farms were inspected.

The commissioner believes that the daily press, by arousing an interest in the subject, might bring about a much needed improvement in the milk supply.

PENNSYLVANIA.

John Hamilton, secretary of agriculture, Harrisburg.

Session of 1895, No. 258; 1893, No. 96; 1885, No. 186; 1878, No. 183; and 1869, No. 56, refer to milk, etc. The dairy and food commissioner is charged with the enforcement of laws concerning dairy products. The councils of cities and boroughs are authorized to provide for milk inspection. Persons peddling milk in cities or villages of over 1,000 inhabitants must have the vehicle marked with name of owner and locality where milk is produced. No person shall knowingly sell adulterated or unwholesome milk. The addition of ice to milk is declared an adulteration, and milk from animals fed on distillery waste, etc., is declared to be impure. The sale, in cities of the second and third classes, of milk to which water or any other foreign substance has been added, or milk from diseased cows (or goats) or cows fed on any putrefying substance is forbidden. In such cities the milk standard is 12.5 per cent solids, 3 per cent fat, specific gravity at 60° F. between 1.029 and 1.033; and skimmed milk may be sold if plainly marked, its standard being 6 per cent cream by volume, 2.5 per cent fat, specific gravity at 60° F. between 1.032 and 1.037. It is the duty of bureaus of health in cities of the second and third classes to register all dairies and milk depots and to require owners' names to be placed upon vehicles delivering milk, and to prevent the sale of adulterated milk.

Session of 1895, No. 233, refers to foods. It forbids the sale of food that is adulterated, which term is defined at length.

Although the supervision of the milk supply of cities is largely under local boards of health, some work along this line has been accomplished by the State department of agriculture.

A bacteriological examination of the milk supply of several cities was made in 1897 and reported upon in the annual report of the department. A recent report of the dairy and food commissioner shows that in 6 months 287 samples of milk from 18 cities and towns and 4 samples of cream from 2 cities were examined. One hundred and ninety-seven of the milk samples and 3 of the cream samples were found to be of good composition; 25 milk samples were skimmed, 32 watered, 42 preserved, and 3 colored. In the majority of cases the milk samples were taken from peddlers or milk depots.

Philadelphia. (Population, 1,293,697.)

[For comparison with other cities in Class I, see p. 28.]

William J. Byrnes, chief inspector of milk.

It is estimated that 75,000 gallons of milk are used daily, or an average of 0.46 pint per capita. Little skimmed milk is used. Milk is sold in about 1,500 stores and served from about 2,000 wagons. A large number of glass jars are used in the retail trade, most of them being filled in the city. Only a small part of the milk is pasteurized. The retail price of milk in the summer and winter is 6 and 8 cents per quart, respectively. Farmers are paid for their milk,[a] delivered in the city, 2½ to 3 cents per quart[b] in the summer period, and 3½ to 4 cents in the winter. The two periods vary in length in different years; for instance, in 1901 the summer period extended over only three months. A few first-class dairies are in the vicinity of Philadelphia and their milk brings an extra price. About 500 herds, including 5,000 cows, are within the city limits. Milk is sent into the city from about 2,500 dairy farms; almost all of it comes by rail, the most distant point of supply being 200 miles away. A large portion of the milk supply is received from the adjoining States—New York, New Jersey, Maryland, and Delaware.

The few State laws which apply to the milk supply of Philadelphia are supplemented by an ordinance of 10 sections, approved September 23, 1890. This prohibits the sale of adulterated or impure milk, including the product of animals kept in a crowded or unhealthy condition, or fed on distillery waste usually called "swill," or any substance in a state of putrefaction or of an unwholesome nature; and milk which has been exposed to the emanations of a person sick with a contagious disease, and milk from tuberculous cows. The milk standard is 12 per cent milk solids and 8.5 per cent solids not fat. Skimmed milk may be sold if its container is plainly labeled. It must contain at least 8.5 per cent of milk solids, exclusive of fat. (By a supreme court decision, there is no legal distinction between partially and wholly or separator-skimmed milk.) The director of the department of public safety is required to appoint an inspector of milk and the necessary assistants, analysts, clerks, and collectors of samples for the enforcement of this ordinance through the board of health. The officers are given authority to examine suspected milk wherever found, and, if their test shows it to be adulterated, to pour it out or return it to the consignor. Samples must be taken in duplicate. The inspector shall each month publish, in such city newspapers as are willing to give space, a full list of all whose milk was tested the previous month and the results of the analyses, with notes to show the extent of deficiency of samples below standard.

The last section of the ordinance states that no person shall be liable for violation

[a] The monthly prices, from 1899 to 1901, received by shippers per quart for milk delivered in the city, freight prepaid, as announced by the Philadelphia Milk Exchange and reported by The Milk Reporter, are as follows:

Month.	1899.	1900.	1901.	Month.	1899.	1900.	1901.
January	3½	4	3½	July	3	3½	
February	3½	3½	3½	August	3	3½	
March	3½	3½	3½	September	3½	3½	4
April	3½	3½	3½	October	3½	3½	4
May	2½	3½	3½	November	4	4	4
June	2½	3½	3	December	4	4	4

[b] In wholesale transactions the "dry" quart is used.

if he shows to the satisfaction of the magistrate or court that he could not have ascertained that the milk was impure, etc.

The amount expended by the city in the supervision of the milk supply the past year was $9,580. Ten officials, including a chief milk inspector, assistant inspectors, and collectors of samples, give their entire time to this work. During the year 47,023 samples were tested by the lactometer, and 95 samples were analyzed to obtain evidence for prosecutions. The lactometer samples represented 1,684,768 quarts, of which 21,384, or 1.25 per cent, were condemned for adulteration with water, 267 for being skimmed, 480 for containing formaldehyde, and 4 for containing coloring matter (annatto). Practically half of the condemnations were upon the railroad receiving platforms, and in such cases, the shippers being beyond the jurisdiction of the inspector, the condemned milk was reshipped with a certificate of condemnation, and the dealer accustomed to handle the product of the dairy was warned not to receive later shipments unless free from adulteration. The percentages of milk examined that was condemned in each month of the year were as follows:

January	1.73	May	0.95	September	1.02
February	1.03	June	1.82	October	1.10
March	1.36	July	1.88	November	.61
April	1.51	August	1.75	December	.12

It is claimed, on the basis of many analyses, that the entire city milk supply will average over 13 per cent total solids and over 4 per cent fat. During the year 390 samples were examined for pus cells, pathogenic germs, etc.; these included numerous samples of milk obtained from houses where there were typhoid fever cases, which were examined with negative results. During the year all the dairies within the city limits were inspected; nothing is known of the conditions obtaining on many of the supplying farms which are beyond the city limits. The successful work of the milk commission of the Pediatric Society is described in the article "Market Milk: A plan for its improvement."[a]

The forms for recording data regarding preliminary inspections of milk are shown in Appendix IV (p. 205).

The form for notice of condemnation of milk and stub for same are shown in Appendix IV (p. 207).

The milk supply has improved in quality, records showing that the percentage found adulterated has fallen from 11.15 in 1892 to about 1.50 in 1900. Suggested improvements include legislation providing for a higher standard for milk and for periodical, thorough, veterinary and sanitary inspection of dairy cattle and dairy farms, and the awarding of certificates where conditions are found to be satisfactory. It is believed that the most practical way to provide for the inspection of dairies, especially those in other States, is to require each dairyman to secure a permit before commencing to sell milk in the city, the permit to be based upon the conditions at his dairy and to be revocable.

Pittsburg. (Population, 321,616.)

[For comparison with other cities in Class I, see p. 28.]

Albert H. Edwards, meat and milk inspector.

Estimated average amount of milk used daily is 30,000 gallons (including the milk and cream used in the ice-cream business), or 0.75 pint per capita. Milk is distributed from 1,230 stores and 425 wagons. About 4,000 gallons is pasteurized; this treatment, however, does not seem to be gaining in favor. Only a small part of the milk is delivered in bottles, and they are filled in the city. The retail price of milk

[a] Seventeenth Annual Report of Bureau of Animal Industry, pp. 158-193.

is 6 to 8 cents per quart in summer and 8 to 10 cents in winter, producers on the farm being paid 3 cents and 3¾ cents in the two seasons. There are 3 or 4 "model dairies" near the city, the milk from which is sold at 10 cents per quart throughout the year. There are 241 dairy herds within the city limits. About 90 per cent of the milk supply is received by railway, the longest shipment being 50 miles.

The city publishes State laws referring to market milk.

In the supervision of its milk supply the city expends annually about $3,000. One official, an assistant milk inspector, gives his entire time to the work, and another a part of his time. During the year 4,997 samples of milk were examined by Babcock test and gravimetric analysis; no bacteriological examinations were made.

The most marked recent improvement has been in facilities for caring for milk. Suggested improvements include thorough inspection of all dairy farms and cattle, sterilizing or thorough scalding of all milk vessels, and examination of cattle for tuberculosis twice a year.

Allegheny. (Population, 129,896.)

[For comparison with other cities in Class I, see p. 28.]

John Lippert, meat and milk inspector.

It is etimated that 5,000 gallons of milk are used daily, an average of 0.31 pint per capita. Milk is distributed from 160 stores and 400 wagons. The few bottles used in its delivery are filled in the city. A considerable portion of the milk supply is pasteurized, and the use of such is increasing. The retail price of milk is 6 cents per quart in summer and 8 cents in winter; the producers on the farm receive 3 and 4½ cents per quart in the two seasons. Within the city limits there are 38 herds, including 500 cows. Milk is sent into the city from 90 dairy farms; about two-thirds comes by railway, and the longest shipment is 150 miles.

The city has no milk ordinance; the State laws alone regulate the milk supply.

There is expended annually $2,700 in the supervision of the city milk supply. One inspector and one bacteriologist give all or a large part of their time to this work. About 2,000 samples were examined for fat content and 180 for tubercle and typhoid bacilli, and all of the dairies in the city were inspected during the past year.

The enactment of milk ordinances is strongly recommended.

Scranton. (Population, 102,026.)

[For comparison with other cities in Class I, see p. 28.]

Fred. J. Widmayer, food and milk inspector.

The estimated amount of milk used daily is 7,000 gallons, or 0.55 pint per capita. Milk is distributed from 170 stores and 125 wagons, and about 75 per cent of it is delivered in glass jars. A number of the large concerns, handling perhaps half of the jars, do their bottling at milk-receiving stations in the country. Little, if any, pasteurized milk is used. The retail price of milk is 6 cents per quart in summer and 7 cents in winter, producers receiving 1¾ cents in summer and 2½ cents in winter. No dairy near the city is conducted in what might be called an entirely satisfactory manner. There are only two herds within the city limits; they include 25 cows. Milk is sent into the city from about 400 dairy farms, the most distant being 30 miles.

The milk supply is regulated by State laws applying to cities of the second and third classes, and by a few sections enacted several years ago by the city board of health. The latter provide as follows: The sale of adulterated milk, milk with any foreign substance added, or milk "from cows fed upon brewery grains or other deleterious substances," is prohibited. Wholesale and retail dealers are required to procure licenses annually from the board of health and display same prominently.

All milk cans must be numbered, and cans containing skimmed milk must be plainly labeled. Delivery wagons shall show the name of owner and number of license.

About $1,200 per year is expended by the city in the supervision of its milk supply. One food and milk inspector gives his entire time to this work. In the past year 2,612 samples of milk were examined by the lactometer and the Babcock test; no bacteriological examinations were made. None of the dairies, either within or outside the city, have been inspected.

There has recently been a decrease in the practice of adulterating milk by the addition of water. Needed improvements as given include the extension of the inspector's authority to dairies beyond the city limits, frequent inspection of those dairies, and regulations as to the use of ensilage and brewers' grains.

Reading. (Population, 78,961.)

[For comparison with other cities in Class II, see p. 32.]

Peter Texter, market commissioner.

The daily consumption of milk is estimated as 4,200 gallons, or an average of 0.43 pint per capita, besides 1,400 gallons of skimmed milk and 175 gallons of cream. Milk is sold from about 20 stores and 145 wagons. A very small amount of milk is delivered in glass bottles, and these are filled at the farms. One-seventh of the milk is pasteurized, and the practice is gaining in favor. The consumers pay 6 cents and the producers receive 3 cents per quart for milk throughout the year. There are no herds within the city limits. Milk is brought to the city in wagons from 145 dairy farms, the longest haul being 8 miles.

The city prints State laws regulating the milk supply.

There is expended annually $185 in the supervision of the milk supply. The market commissioner gives a part of his time to this work. During the past year 121 samples of milk were examined by the lactometer; no bacteriological examinations were made.

Erie. (Population, 52,733.)

[For comparison with other cities in Class II, see p. 32.]

J. K. Hallock, secretary of the board of health.

The daily consumption of milk is estimated as 3,600 gallons, or an average of 0.54 pint per capita, besides 250 gallons of skimmed milk and 150 gallons of cream. Milk is sold from 123 stores and 78 wagons. A very limited amount of milk is delivered in glass bottles which are filled at the producing farms and in the city. Very little milk is pasteurized, and the practice is not increasing. The retail price of milk is 5 cents per quart throughout the year, producers receiving $2\frac{1}{2}$ and $2\frac{3}{4}$ cents in summer and winter, respectively. There are no "model dairies" near the city. Within the city there are 3 herds, including 25 cows. Wagons bring in milk from 100 dairy farms, the longest haul being 15 miles.

Rules and regulations (17 sections) of the board of health refer to the city milk supply. Permits for the sale of milk or cream are issued free of charge. Adulterated, etc., milk is prohibited. Cows supplying milk must be examined by a veterinarian (not necessarily with the tuberculin test) within one year. Cow stables must be clean and, like milk rooms, must be properly located and constructed. From June to September milk and cream vehicles must be equipped with ice boxes. Milk bottles, etc., must be properly cleaned after use, and must not be taken from a quarantined house without the permission of the board of health. Persons exposed to or suffering from contagious disease must not handle milk or cream for sale. The food inspector must inspect, at least once a month, all stores and wagons from which milk is sold and take samples therefrom for analysis.

For the full text of the rules and regulations of the board of health concerning the milk supply, see Appendix I (p. 174).

During the past year 1,758 samples of milk were examined by the Babcock test, and by gravimetric analysis, the lactometer being used in a few instances. No bacteriological examinations were made. All the city herds and all the dairy farms were inspected. The large number of samples examined shows that the law requiring the inspection of each dealer's milk once a month is well observed.

The form used for application for milk license is shown in Appendix IV (p. 189).

The form for report upon inspection of dairies is shown in Appendix IV (p. 196).

Wilkesbarre. (Population, 51,721.)

[For comparison with other cities in Class II, see p. 32.]

Walter Davis, M. D., water and milk inspector.

The daily consumption of milk is estimated as 2,890 gallons, or an average of 0.45 pint per capita. This is sold from about 40 stores and 60 wagons. Only one dealer supplies milk in glass bottles, and these are filled some in the city and some in the country. A very small quantity of milk is pasteurized; and the practice is not increasing. The retail price of milk is 6 cents per quart in summer and 8 cents in winter, producers receiving 2½ cents and 3½ cents in the two seasons. A few dairies are conducted in a very satisfactory manner, but receive no advance in price for their product. There are no city herds. Fifty-three dairy farms near the city furnish about one-half of the total supply; the balance is received by railway, the longest shipment being 130 miles.

An ordinance adopted in October, 1896, supplements the State laws in regard to the milk supply. Persons selling milk must register with the water and milk inspector and report to him the location of dairy farms.

The water and milk inspector (salary, $600) gives a part of his time to the supervision of the milk supply. During the past year 350 samples of milk were examined by the lactometer, and suspected samples by the Babcock test; and the 53 nearby dairy farms were inspected. On 15 farms conditions were found to be satisfactory, on 21 fairly satisfactory, and on the remainder unsatisfactory.

A milk laboratory and a dairy inspector are much needed.

Harrisburg. (Population, 50,167.)

[For comparison with other cities in Class II, see p. 32.]

The daily consumption of milk is estimated as 2,500 gallons, or an average of 0.40 pint per capita; also 1,000 gallons of skimmed milk and 125 gallons of cream. Milk is sold from 12 stores and 75 wagons. About 5 per cent of the total supply is delivered in glass bottles, and these are filled in the city. No milk is pasteurized. The retail price is 5 to 6 cents per quart in summer and 6 cents in winter, producers receiving 3 cents and 4 cents in the two seasons. The milk from one especially well-conducted dairy is sold for 7 cents per quart throughout the year. Within the city limits there are 2 dairy herds, including 20 head, and milk is sent in from 90 dairy farms. Only about 8 per cent of the milk supply is received by railway, the longest shipment being 15 miles.

The city exercises practically no supervision over its milk supply.

It has been suggested that the best way to improve the quality of the milk is to bring to the attention of the public the advantages of pure milk and encourage those who produce it; and that flagrant violations of the milk laws should be promptly prosecuted.

Lancaster. (Population, 41,459.)

[For comparison with other cities in Class III, see p. 38.]

M. W. Raub, secretary and physician of the board of health.

The estimated daily consumption of milk is 1,800 gallons, or 0.35 pint per capita, besides 50 gallons of cream. Milk is sold from 12 stores, 96 wagons, and 50 private

houses. Three-fourths of the milk is delivered in glass bottles, half of these being filled on the farms and the rest in the city. About 150 gallons of milk is pasteurized daily, which practice is increasing very slowly. The retail price of milk is 5 to 6 cents per quart throughout the year, producers receiving 2½ to 3 cents. About 10 dairies are conducted in a satisfactory manner, their milk being sold at the regular price. Within the city limits there are 58 milch cows, kept in 28 stables, and milk is sent in from 145 dairy farms. Only 58 gallons of milk is received daily by railway, the longest shipment being 14 miles.

State laws, supplemented by city ordinances, govern the milk supply. The milk inspector is authorized to destroy all impure and adulterated milk. License fee for the sale of milk is $1, and $1 for each wagon after the first.

During the past year only $8 was expended by the city in the supervision of its milk supply; 505 milk samples were examined by the lactometer and Babcock test; all the city herds and 80 of the 145 dairy farms were inspected. The secretary of the board of health in 1898 made a thorough inspection of all the dairies producing milk for use in the city.

His annual report gives an interesting account of the conditions under which the milk supply is produced, and includes the following statement:

	Number.
Places inspected outside of city limits	76
Cows seen	950
Cows in first-class condition	700
Cows in middling condition	100
Cows in poor (unsanitary) condition	150
Cows died during the year	5
Acres farm land	6,024
Acres pasture	700
Stables inspected	76
Stables in good condition	50
Stables unsanitary	20
Quarts of milk furnished daily	6,000
Quarts of cream furnished daily	200
Food used. Corn, chop, bran, ship stuff, malt, and pasture:	
Places using malt with other food	22
Places using malt alone	2
Places using pasturage alone	2
Total milk houses inspected	68
Total milk houses, sanitary and best condition	55
Total milk houses, good (ventilation wanting)	13
Cans and vessels for milking and storing almost all neat, clean, and well cared for.	

Recent improvement has been shown in the cleanliness of stables and care in handling milk. A law regulating the sanitary condition of dairies is said to be much needed.

Altoona. (Population, 38,973.)

[For comparison with other cities in Class III, see p. 36.]

J. D. Miller, health officer.

Estimated daily consumption of milk is 3,500 gallons, or 0.72 pint per capita. Milk is sold from 25 stores and 40 wagons. Four dairies deliver milk in glass bottles, and these are filled both in the city and at the farms. Little or no milk is pasteurized. The retail price of milk is 6 cents per quart in summer and 7 cents in winter, producers receiving 4 and 5 cents in the two seasons. Within the city limits there are 2 herds, including 20 cows. About 50 per cent of the milk is received by railway, the longest shipment being 15 miles.

Nothing is expended by the city in the supervision of its milk supply. During the past year 36 samples of milk were analyzed by the State chemist, and no bacteriological examinations were made.

A recent improvement in the quality of the milk is due to a decrease in the use of formaldehyde.

Johnstown. (Population, 35,936.)

No reply to inquiries was received.

Allentown. (Population, 35,416.)

[For comparison with other cities in Class III, see p. 36.]

Morris F. Cawley, health officer.

Milk retails at 6 cents per quart throughout the year.

The city does practically no inspection work, and no record of the milk supply is kept. During the past year 40 milk samples were examined by Marchand's test.

McKeesport. (Population, 34,227.)

[For comparison with other cities in Class III, see p. 38.]

A. C. Wallace, secretary of the board of health.

The estimated daily consumption of milk is 2,000 gallons, or 0.47 pint per capita. Milk is sold from a number of stores and 50 wagons. Within the city limits there are 15 herds, including 30 cows, and about 12 dairy farms send milk into the city, the longest distance being 5 miles.

During the past year no inspection work has been done.

Chester. (Population, 33,988.)

[For comparison with other cities in Class III, see p. 38.]

W. G. Monroe, secretary of the board of health.

The daily consumption of milk is estimated as 1,625 gallons, or 0.38 pint per capita, besides 600 gallons of skimmed milk. Milk is sold from 28 stores and 59 wagons. Retail price of milk is 6 cents per quart in summer and 8 cents in winter, producers receiving 3 and 4 cents, respectively. Milk is supplied from 70 dairy farms. One hundred gallons is received by railway daily, the longest shipment being 10 miles.

The city has no milk inspector.

York. (Population, 33,708.)

[For comparison with other cities in Class III, see p. 38.]

Francis X. Weil, M. D., health officer.

Estimated daily consumption of milk is 1,350 gallons, or 0.32 pint per capita, besides 150 gallons of skimmed milk and 25 gallons of cream. Milk is sold from about 25 stores and 40 wagons. Three-fourths of the milk supply is delivered in glass bottles filled in the city. Pasteurized milk is delivered by only 1 wagon, and its use is not increasing. Milk is retailed at 5 cents per quart throughout the year, producers being paid 3 cents. There are no "model dairies" near the city, and no dairy herds within the city limits. Milk is sent in from 28 dairy farms, all within 8 miles of the city; none is received by railway.

The city has an ordinance forbidding the sale of adulterated milk, but exercises no supervision over its milk supply.

Williamsport. (Population, 28,757.)

[For comparison with other cities in Class III, see p. 38.]

C. W. Youngman, M.D., health officer.

Estimated daily consumption of milk is 875 gallons, or 0.24 pint per capita. Milk is sold from 14 stores and 90 wagons. About one-half is delivered in glass bottles filled at the farms. No milk is pasteurized. Retail price of milk is 5 cents per quart in summer and 6 cents in winter, producers receiving 2½ and 3 cents, respectively. The milk from 3 well-conducted dairies near the city is sold at the regular price. Within the city limits there are 4 herds, including 25 cows, and milk is sent in from 127 dairy farms. About one-seventh is received by railway, the longest shipment being 50 miles.

The health officer (salary $1,000) gives a part of his time to the supervision of the city milk supply. During the past year 73 milk samples were examined by lactometer and cream gauge; no bacteriological examinations were made; all the city herds and all the dairy farms were inspected. A report of the conditions obtaining at the dairy farms is published annually in the daily papers by the board of health. The dairies are divided into three classes: The first includes those having everything necessary for the production of good milk, the second those less well equipped, and the third includes dairies having the poorest equipment.

Newcastle. (Population, 28,339.)

[For comparison with other cities in Class III, see p. 38.]

W. H. Vance, health officer.

The estimated daily consumption of milk is 700 gallons, or 0.20 pint per capita, besides 150 gallons of skimmed milk and 150 gallons of cream. Milk is sold from about 75 stores and 75 wagons, and is retailed at 6 cents per quart in summer and 7 cents in winter. There are no dairy herds within the city limits. Milk is sent in from 75 dairy farms, all within a radius of 7 miles of the city.

The city has no milk ordinance and exercises no supervision over its milk supply.

Easton. (Population, 25,238.)

No reply to inquiries was received.

Lebanon. (Population, 17,628.)

[For comparison with other cities in Class IV, see p. 42.]

W. L. Brunner, secretary of the board of health.

The daily consumption of milk is estimated as 1,500 gallons, or an average of 0.68 pint per capita, besides 200 gallons of skimmed milk and 300 gallons of cream. Milk is sold from 45 wagons, a large amount being delivered in glass bottles filled both at the farms and in the city. No milk is pasteurized. The retail price is 6 cents per quart throughout the year, producers receiving 2 cents and 3 cents in the two seasons. There are no "model dairies" near the city. Within the city limits there are 15 herds, including about 60 cows, and milk is brought in wagons from 60 dairy farms, the longest haul being 8 miles.

The city has no milk ordinance.

About $100 is expended annually in the supervision of the milk supply. During the past year 70 samples of milk were examined by the Babcock test, no bacteriological examinations were made; 12 of the 15 city herds, but none of the dairy farms, were inspected.

Meadville. (Population, 10,291.)

[For comparison with other cities in Class IV, see p. 42.]

C. Courtney McLean, V. S., milk inspector.

The daily consumption of milk is estimated as 875 gallons, or 0.68 pint per capita. Milk is sold from 2 stores and 30 wagons. Perhaps one-fifth of it is delivered in glass bottles, most of these being filled at the farms; none is pasteurized. The retail price is 6 cents per quart throughout the year, producers receiving 3 cents. There are no "model dairies" near the city. Milk is brought in wagon from 30 dairy farms (489 cows), the longest haul being 4 miles.

There is no herd within the city.

Board of health rules Nos. 9, 36, 50, and 56–66 refer to milk. Any person wishing to sell milk must apply for an inspection of his cattle, appointments, etc., and agree to observe certain regulations. The milk inspector must, previous to the issuing of permits, and annually, inspect all dairies, cows, and appointments for supplying milk for sale in the city. Milk from diseased cows, adulterated milk, etc., is prohibited. The milk standard is 12.5 per cent solids, 3.5 per cent fat, specific gravity between 1.029 and 1.033. Milk exposed to infection by contagious disease shall not be sold.

There is expended annually $200 in the supervision of the milk supply, one official giving a part of his time to this work. During the past year 976 samples were examined by lactometer and Babcock test; no bacteriological examinations were made; all the dairy farms were inspected. The milk inspector has published, in a little pamphlet, the milk regulations, together with practical suggestions for the guidance of dairymen. These cover the stabling, feeding, and care of cattle, and the care of milk.

The form used for making application for inspection is shown in Appendix IV (p. 189).

Recently more care in cooling and cleaner methods have obtained at dairies. It is stated that inspections should be more frequent and that the rules should be enforced requiring the exclusion of unhealthy cows from dairy herds, the proper care and handling of milk, etc.

Phœnixville. (Population, 9,196.)

[For comparison with other cities in Class IV, see p. 42.]

E. M. Massinger, V. S., veterinary inspector.

The daily consumption of milk is estimated as 725 gallons, or 0.63 pint per capita, besides 30 gallons of skimmed milk and 10 gallons of cream. Milk is sold from 3 stores and 37 wagons. About one-third of the dealers deliver milk in glass bottles filled at the farms; none is pasteurized. The retail price is 5 cents per quart throughout the year, producers receiving 2 to 2½ cents in summer and 3 to 3½ cents in winter. Within the city limits there are 7 herds, including about 60 cows, and milk is brought in wagons from 55 dairy farms, the longest haul being 5 miles.

An ordinance in effect July, 1894, refers to milk. License is required for the sale of milk. Impure, adulterated, etc., milk is prohibited, and may be destroyed. The milk standard is 12.5 per cent solids, 3 per cent fat, specific gravity not less than 1.029. Skimmed milk must be labeled and contain 2.5 per cent fat, 6 per cent of cream by volume.

About $100 is expended in the supervision of the milk supply. During the past year 496 samples were examined by the lactometer, and 8 of the 55 dairy farms were inspected.

The inspector recommends an ordinance excluding all tuberculous cows from dairy herds.

RHODE ISLAND.

General laws of 1896, chapter 147; and laws of 1896, chapter 333; and 1900, chapter 785, refer to milk, etc. The mayor and aldermen of any city and the council of any town may select milk inspectors; in Providence this is compulsory. Notice of the selection shall be published. Inspectors shall record names and addresses of persons selling milk, take samples of milk supposed to be impure, etc. They may appoint sample collectors. Chiefs of police, milk inspectors, special constables, etc., may prosecute. The sale of milk from cows fed upon distillery refuse or other deleterious substance, or milk from diseased cows or milk to which water or any foreign substance has been added, is forbidden. The milk standard is 12 per cent solids, 2.5 per cent fat. Skimmed milk must be plainly labeled. The name and address of any person convicted shall be published in his town or county. Milk is required to be sold by wine measure, and measures used in its sale must be sealed.

Providence. (Population, 175,597.)

[For comparison with other cities in Class I, see p. 28.]

Walter O. Scott, inspector of milk.

The daily receipts of milk is estimated as 22,000 gallons, or 1 pint per capita, besides a small amount of skimmed milk and quite a large amount of cream. The amount of milk consumed as such can not be definitely stated because a large portion of the receipts is used in the butterine factories located in the city; also the official records are kept in such a manner that milk which is wholesaled may be recorded more than once. Milk is sold from 1,200 shops and 500 wagons. Glass bottles are used in the delivery of 3 per cent of the milk and 99 per cent of the cream, the former being bottled at the producing farms and the latter in the city. Little or no attention is given to the pasteurization of milk. The retail price of milk is 5 to 8 cents per quart in summer and 6 to 8 cents in winter. There are 6 or 8 dairies in this locality conducted in a satisfactory manner, but not receiving an extra price for their milk. The number of cows in the city is not known. It is estimated that one-third of the total milk supply is received by railway, the longest shipment being 60 miles.

State laws are depended upon to regulate the milk supply.

The supervision of the milk supply costs the city about $6,000 annually. Four officials—an inspector, two collectors of samples, and one clerk—give their entire time to the work. During less than half of the past year 3,178 samples of milk were examined either by the Babcock test or gravimetric analysis, or both. During the year examinations were made of 200 samples to determine bacterial content.

According to the milk inspector, the percentage of milk—that is, adulterated—found for sale in stores has fallen from 28.67 in 1898 to 11.79 in 1901, and in the same period the percentage of adulterated milk found on wagons has fallen from 17.12 to 7.34. During this time the prosecutions averaged in number about 6 per month. The city milk inspector appears at prosecutions only as a witness. Milkmen are prosecuted without warning if their milk contains less than 11.50 per cent total solids, and storekeepers are prosecuted without warning when their milk shows less than 11 per cent total solids, and after warning if below 11.5 per cent. The milk inspector's report contains much interesting matter regarding the production and handling of milk, and quite a full discussion of the work performed in his office.

Forms for keeping the records of the milk inspector's office by the "card system" are shown in Appendix IV (p. 210).

Needed improvements as given include the raising of the legal standard for milk to 3.5 per cent fat; the adoption of standards for cream and skimmed milk; the licensing of dealers so that dishonest persons can be kept out of the business; the

delivery of milk to the consumer just as it is put up at the dairy or store, thereby preventing its being turned from one vessel to another on wagons in open air; the establishment of a State dairy bureau to have supervision of all the dairy interests of the State.

Pawtucket. (Population, 39,231.)

[For comparison with other cities in Class III, see p. 38.]

A. J. Johnson, jr., inspector of milk.

Estimated daily consumption of milk is 2,955 gallons, or 0.60 pint per capita, besides 75 gallons of skimmed milk. This is sold from 80 stores and 125 wagons. Glass bottles, filled at the farms, are used largely in the delivery of milk. No milk is pasteurized. The retail price of milk is 5 to 6 cents per quart in summer and 6 to 7 cents in winter, producers being paid 3 cents and 3½ cents, respectively. The milk from two "model dairies" is sold at 7 cents per quart throughout the year. There are no dairy herds in the city. Milk is sent in from 200 dairy farms. Only about 2 per cent is received by railway, the longest shipment being 5 miles.

About $400 is expended annually by the city in the supervision of its milk supply, the milk inspector giving a part of his time to this work. During the past year 300 samples of milk were examined by lactometer and gravimetric analysis; no bacteriological examinations were made; one dairy farm was inspected.

Recently the milk has improved in composition. It is recommended that milk dealers be licensed, so that the privilege to sell milk can be denied those who evade the law.

Woonsocket. (Population, 28,204.)

[For comparison with other cities in Class III, see p. 38.]

William C. Mason, city clerk.

This city has no ordinance regulating its milk supply, and information on this subject is not obtainable.

SOUTH CAROLINA.

Acts of 1896, No. 96, sections 1 and 2, refer to milk. It is unlawful for any person knowingly to sell impure or adulterated milk or milk from animals diseased or having ulcers, etc. The milk standard is 8.5 per cent solids not fat, 3 per cent fat. Skimmed milk and buttermilk, when sold, must not be misrepresented.

Charleston. (Population, 55,807.)

[For comparison with other cities in Class II, see p. 32.]

J. Mercier Green, M. D., health officer.

The daily consumption of milk is given as 720 gallons, or an average of 0.10 pint per capita, besides 8 gallons of skimmed milk and 1 gallon of cream. In explanation of this apparently low consumption, it is stated that many private families keep from 1 to 12 cows and dispose of milk and cream. The quantity of milk produced by these cows is unknown, and is not included in the above estimate. Milk is sold from 6 wagons. Only a very small quantity of milk is delivered in glass bottles, and little or none is pasteurized. The retail price of milk is 8 cents per quart throughout the year. There are no "model dairies" near the city. No milk is shipped in by railway, the greater part of it being brought in boats from the near-by islands.

The city expends nothing for milk inspection. During the past year the board of health made bacteriological examinations of 27 samples of milk; none of the herds within the city was inspected and only 1 dairy farm outside the city was inspected.

The passage and enforcement of an ordinance regulating the production and handling of milk is said to be much needed.

SOUTH DAKOTA.

C. P. Sherwood, State food and dairy commissioner, Desmet.

Laws of 1897, chapter 65, amended, and 1899, chapter 89, sections 23 to 29, and an act approved March 7, 1901, refer to foods and milk. The food and dairy commissioner shall enforce food and dairy laws, and may take samples for analysis, etc. Chemists at State institutions shall analyze samples. Cows for production of market milk shall not be kept in an unhealthy condition or fed upon food that will produce impure or unwholesome milk. It is unlawful to sell, without fully informing the buyer, any food that is adulterated, which term is defined at length.

TENNESSEE.

Public acts of 1897, chapter 45, refers to foods, and prohibits the sale of any food that is adulterated, which term is defined at length.

Memphis. (Population, 102,320.)

[For comparison with other cities in Class I, see p. 28.]

Felix Paquin, chemist and bacteriologist.

The daily consumption of milk is estimated as 6,400 gallons, or 0.05 pint per capita. Milk is sold from 40 stores (including hotels, etc.) and 168 wagons. There are no large milk depots in the city. Glass bottles are used in the delivery of about one-third of the milk, and they are filled at the producing farms. The entire product of one dairy is pasteurized, and finds ready sale. Consumers pay 6 cents per quart for milk throughout the year. There is one comparatively extra well conducted dairy in the locality which receives 8 cents per quart for its product. One hundred and eighty-eight dairy farms, having 3,554 cows, send milk into the city, quite a large amount of which is received by railway, the longest shipment being 527 miles.

According to reports there were within the city limits in the year 1899, 105 herds, including 891 cows; 55 of these "herds" consisted of from 1 to 3 cows each, which were kept for private use, and there were 115 dairy farms, having 1,723 cows, sending milk into the city. The longest distance milk was then sent to the city was 212 miles.

An ordinance passed in July, 1898, regulates the milk supply. Permit from the board of health is required for the sale of milk or any other dairy product. The permit number and name of dairyman must be shown on delivery wagons. The ordinance prohibits the sale of adulterated or unwholesome milk, including milk from animals diseased or kept under crowded or uncleanly conditions, or fed on distillery waste or other unhealthy food, or watered with polluted water; milk drawn from cows fifteen days before or five days after calving; milk which has been in containers that were dirty or were washed with polluted water; milk from which cream has been removed; and milk containing an antiseptic. The milk standard is 12 per cent solids, 3 per cent fat.

A copy of the milk ordinance is shown in Appendix I (p. 173).

About $1,200 is expended annually in the supervision of the city milk supply. One chemist and bacteriologist and 1 inspector of dairies and collector of milk samples give a part of their time to this work. During the year 1,083 samples were examined by the Babcock test, chemical analysis, microscopically, and bacteriologically; 36 examinations were made for pus cells and the bacilli of tuberculosis and typhoid fever; and 153 dairy farms were inspected. For the adulteration of milk 46 warrants were issued, and fines to the amount of $710 were imposed; 13 cows were destroyed on account of tuberculosis.

In the previous year 1,529 samples of milk were tested for fat by the Babcock test

and 486 samples were examined for water and total solid content, preservatives, and microscopically for foreign substances; 11 bacteriological examinations were made; all of the city herds and 13 of the 188 dairies outside of the city, about which complaints had been made, were inspected; 49 warrants were issued for adulterating, use of preservatives, etc.; $505 in fines were imposed.

There has been great improvement in the quality of milk since the city inspection commenced about three years ago. It was then common to find 50 per cent added water and the free use of preservatives. Needed improvements include more frequent inspection of dairy farms and herds, the use of tuberculin where tuberculosis is suspected, more severe penalties for violation of the milk laws, and better methods of handling milk from its production to its sale.

Nashville. (Population, 80,865.)

[For comparison with other cities in Class II, see p. 32.]

Larkin Smith, M. D., city health officer.

The daily consumption of milk is estimated as 6,802 gallons, or an average of 0.67 pint per capita. Milk is sold from 13 stores and 198 wagons. There are no herds of milch cows within the city limits. Milk is sent in from 193 dairy farms, including 3,401 cows. Only a very small portion is shipped in by railway, the longest shipment being 18 miles.

An ordinance regulates the milk supply. Permits for the sale of pure milk are issued free of charge. Adulterated, impure, etc., milk is prohibited. The milk standard is 12.5 per cent total solids. Skimmed milk must be plainly labeled. Buttermilk may be sold.

During the past year 2,570 samples were examined for total solids and preservatives; no bacteriological examinations were made, and none of the dairy farms were inspected.

The permit for selling milk has printed upon it a full copy of the milk ordinance.

Knoxville. (Population, 32,637.)

No reply to inquiries was received.

Chattanooga. (Population, 30,154.)

[For comparison with other cities in Class III, see p. 38.]

C. A. Baker, clerk of the board of health.

This city has no milk inspector, and information regarding its milk supply is not available.

TEXAS.

Penal Code, 1895, page 80, chapter 2, article 433, defines the milk from a diseased cow as adulterated.

San Antonio. (Population, 53,321.)

[For comparison with other cities in Class II, see p. 32.]

F. Pascal, M. D., health officer.

The retail price of milk is 8 cents per quart in summer and 10 cents in winter. One dairy near the city is said to be conducted in an entirely satisfactory manner.

An ordinance adopted in July, 1901, refers to milk. Milk dealers must have a permit; fee, $1. Each milk vehicle must bear a metal tag or plate furnished by the city clerk. The sale of adulterated milk is prohibited.

There is practically no supervision of the milk supply.

Houston. (Population, 44,633.)

[For comparison with other cities in Class III, see p. 38.]

J. B. Massie, M. D., city health officer.

The estimated daily consumption of milk is 3,800 gallons, or 0.68 pint per capita, besides 100 gallons skimmed milk and 200 gallons of cream. This is sold from 3 stores and 109 wagons. Glass bottles are not used in the delivery of milk. The retail price of milk is 5 cents per quart throughout the year. There are no dairies near the city conducted in an entirely satisfactory manner. Within the city limits there are 19 herds, including 269 cows, and milk is brought to the city in wagons from 128 dairy farms, the longest haul being 6 miles.

An ordinance adopted in May, 1900, governs the sale of milk. Separate permits are issued free for each place of general sale or storage. The sale of impure, adulterated, etc., milk is prohibited. The milk standard is 12 per cent solids, 3.2 per cent fat. Carrying swill, garbage, etc., upon milk wagons is forbidden. Milk coming from outside the city must be exposed for inspection. Condensed milk and buttermilk must be from pure milk. In condensed milk the milk solids shall be equivalent to 12 per cent solids in crude milk, and 26.5 per cent of the solids shall be fat.

About $960 is expended annually by the city in the supervision of its milk supply, one milk and dairy inspector giving his entire time to this work. During the past year 4,775 samples of milk were examined by the lactometer and Babcock test; no bacteriological examinations were made; all the city herds and all the dairy farms were inspected.

Ordinance sections defining the terms adulterated, etc., and referring to milk brought into the city are given in Appendix I (p. 178).

There has been an improvement in the grade of cattle feed used and in the care of cattle.

Dallas. (Population, 42,638.)

[For comparison with other cities in Class III, see p. 38.]

J. H. Florence, health officer.

The estimated daily consumption of milk is 5,250 gallons, or 0.98 pint per capita. Milk is sold from 3 stores and 175 wagons. Ten per cent of the milk is delivered in glass bottles, some filled at the farms, others in the city. One establishment in the city pasteurizes milk and the practice is increasing. Milk is retailed at 4 to 5 cents per quart throughout the year. There are no dairy herds within the city. Milk is brought to the city in wagons from 150 dairy farms, within a radius of 8 miles.

The amount expended in the supervision of the city milk supply is not kept separate from the other expenditures of the board of health. During the past year milk samples were examined by the lactometer; all the dairy farms were inspected. The watering of milk and use of boric acid are common forms of adulteration.

Galveston. (Population, 37,789.)

[For comparison with other cities in Class III, see p. 38.]

C. H. Wilkinson, health physician.

About 5 per cent of the milk is delivered in glass bottles, but none is pasteurized. Milk retails for as high as 15 cents per quart throughout the year. Within the city limits there are 10 herds, including 50 cows. About 10 per cent of the total milk supply is received by railway, the longest shipment being 29 miles.

The city has no milk ordinances, and exercises no supervision over its milk supply, but 8 of the city herds were examined during the past year.

As a means of improving the milk supply consumers are urged to patronize honest dairymen whose methods are cleanly.

Fort Worth. (Population, 26,688.)

[For comparison with other cities in Class III, see p. 38.]

H. C. Whitehead, M. D., city health officer.

The city has no milk inspector and no regulations regarding the milk supply, except a general provision referring to milk exposed for sale.

UTAH.

Moroni Heiner, State dairy and food commissioner, Morgan City.

Laws of 1896, chapter 60, sections 1 to 5, and laws 1897, chapter 54, refer to milk, etc. The dairy commissioner is charged with the enforcement of all laws concerning dairy products. County attorneys shall assist. It is unlawful to sell as pure any milk that is adulterated, skimmed, or impure, which includes milk from a cow within 20 days before and 5 days after parturition or from a cow that has a disease, ulcers, etc. Skimmed milk must be plainly marked; its standard is 9 per cent solids not fat. Standard tests and lactometers may be used to determine quality. Preservatives are prohibited.

Salt Lake City. (Population, 53,531.)

[For comparison with other cities in Class II, see p. 32.]

Horace H. Smith, clerk of the board of health.

The daily consumption of milk is estimated as 2,300 gallons, or an average of 0.34 pint per capita. This is sold from 20 stores and 57 wagons. Seventy dairymen hold permits from the board of health. About two-thirds of the milk is delivered in glass bottles filled in the city. Fifty per cent of the total supply is pasteurized and the practice is increasing. The retail price of milk is 5 cents per quart throughout the year, producers receiving 2¼ to 2½ cents in summer and 2½ cents in winter. The milk from two especially well-conducted dairies is sold at the regular price. About 1,000 gallons of milk is produced by cows kept by private families. In addition to these there are within the city limits 25 herds, including 250 cows. The longest shipment of milk to the city by railway is 35 miles.

An ordinance adopted in August, 1894, amends a previous milk ordinance. Permits for the sale of pure milk are granted after the premises, cows, and milk vessels have been inspected and a sample of the milk has been analyzed. Yearly license fee shall be paid as follows: On daily sales of not more than 2 gallons, $1; on daily sales of 2 gallons and not more than 5 gallons, $3; on each additional 5 gallons or part thereof sold daily, $2.50. Adulterated, etc., milk is prohibited. The milk standard is total solids, 12 per cent; fat, 3 per cent; solids not fat, 9 per cent; ash, 0.68 per cent.

During the past year the office of food inspector was abolished, and there has since been very little supervision of the milk supply. Forty samples of milk were examined by the lactometer and Babcock test, and 15 were tested for preservatives.

The form for report upon inspection of dairies is shown in Appendix IV (p. 196).

Recent improvements in the milk are attributed largely to the decreased use of brewers' malt and the increase in the practice of pasteurization. The present need, as stated, is the instruction of milk producers in cleanly methods.

VERMONT.

Statutes of 1894, sections 4300, 4327 to 4331, and 4975; laws of 1898, Nos. 81 and 115, refer to milk, etc. No person shall sell milk that is diluted with water, adulterated, or skimmed. The milk standard is 12.5 per cent total solids, 9.25 per cent solids not fat, except in May and June, when it is 12 per cent total solids. Results of analyses

at the State agricultural experiment station are competent evidence for prosecution. Milk tests for the basis of payments must be accurate, and persons making such tests must hold certificates. Wine measure is the standard measure. The State board of health is authorized to make chemical and bacteriological examinations of milk.

VIRGINIA.

Acts of 1899–1900—page 694, chapter 655, refers to foods. It provides that the State board of agriculture shall examine samples of foods and may publish results. It forbids the sale of any food that is adulterated, which term is defined at length.

Richmond. (Population, 85,050.)

[For comparison with other cities in Class II, see p. 32.]

John A. Haley, secretary of the board of health.

The daily consumption of milk is estimated as 4,000 gallons, or an average of 0.38 pint per capita, besides 100 gallons of cream. Milk is sold from 100 stores and 150 wagons. Glass bottles, filled in the city, are used in the delivery of a small portion of the milk supply. No milk is pasteurized. The retail price of milk is 6 cents per quart throughout the year, producers receiving 3½ cents. There are no "model dairies" near the city, nor are there any dairy herds within the city limits. Milk is supplied from 150 dairy farms. Five per cent is received by railway, the longest shipment being 35 miles.

There is no inspection of milk or dairies.

Norfolk. (Population, 46,624.)

[For comparison with other cities in Class III, see p. 38.]

A. P. Pannill, secretary of the board of health.

This city has no milk ordinance and no milk inspector, and does not exercise supervision over the milk supply.

WASHINGTON.

E. A. McDonald, State dairy and food commissioner, Seattle.

Laws of 1899—chapter 43 refers to milk, etc. It is the duty of the State dairy commissioner to enforce all laws relating to dairy products. Chemists at State institutions shall make analyses. Attorney-general and county attorneys shall give legal assistance. Persons selling milk in cities and towns must obtain a license annually in June, from the dairy commissioner, at a cost of $1. A separate license is required for each vehicle, and the latter must show license number and owner's name and business address. It is unlawful to sell as pure any milk that is impure, adulterated, or skimmed, including milk known to be from cows diseased or having ulcers, etc., or within fifteen days before and four days after parturition; milk from cows kept in an unhealthy condition or fed on distillery waste or other putrefying or unhealthful substance; milk exposed to contamination by persons or animals, or milk to which preservatives have been added. And it is unlawful to sell cream from impure or diseased milk. The milk standard is 8 per cent solids not fat, 3 per cent fat. The cream standard is 18 per cent fat. Skimmed milk may be sold only when plainly marked. Proprietors of dairies and all milk venders must report to the dairy commissioner the amount of milk handled. Milk dealers must have their cans marked to show capacity.

Laws of 1899—chapter 113 refers to foods. It forbids the sale of food that is adulterated, and this term is defined at length.

There were 391 licenses issued by the dairy commissioner in the past year. By counties they were as follows:

Adams	1	Kittitas	3	Stevens	1
Chehalis	16	Lewis	1	Thurston	1
Clallam	5	Lincoln	7	Walla Walla	10
Clarke	5	Mason	3	Whatcom	11
Cowlitz	1	Okanogan	2	Whitman	10
Ferry	4	Pacific	9	Yakima	4
Franklin	2	Pierce	48	Total	391
Island	1	Skagit	2		
Jefferson	7	Snohomish	20		
King	139	Spokane	78		

Forty-four samples of milk have been analyzed and all of them found to be unadulterated.

Seattle. (Population, 80,671.)

[For comparison with other cities in Class II, see p. 32.]

M. E. A. McKechnie, M. D., health officer.

L. M. Woodcock, milk and dairy inspector.

The daily consumption of milk is estimated as 9,200 gallons, or an average of 0.91 pint per capita, beside 400 gallons of skimmed milk and 700 gallons of cream. Milk is sold from 142 stores and 87 wagons. A very limited amount of milk is delivered in glass bottles, and these are filled in the city. Only one firm pasteurizes milk, and the practice is not increasing. The retail price of milk is 5 cents per quart in summer and 7 cents in winter, producers receiving 2½ cents and 3½ cents in the two seasons. There are no "model dairies" near the city. Within the city limits there are 21 herds, including 400 cows, and milk is sent in from 76 dairy farms. About two-thirds of the total milk supply is received by railway, the longest shipment being 44 miles.

The milk standard is said to be 3 per cent fat, 9 per cent other solids.

About $1,200 is expended annually in the supervision of the city milk supply, one official—a milk and dairy inspector—giving his entire time to this work. During the past year 2,400 milk samples were examined by the Babcock test; 117 samples were analyzed gravimetrically; no bacteriological examinations were made; all the city herds and all the dairy farms were inspected.

Recently there has been a marked decrease in the sale of adulterated milk. Needed improvements, as given, include better dairy buildings and greater care in the production and handling of milk.

Tacoma. (Population, 37,714.)

[For comparison with other cities in Class III, see p. 38.]

Harry H. Collier, deputy State dairy commissioner.

The number of cows supplying milk to Tacoma is 1,100, and these are included in 21 herds. Two hundred and six milk samples were tested in six months in the past year.

Spokane. (Population, 36,848.)

[For comparison with other cities in Class III, see p. 38.]

James Bullivant, V. S., deputy State dairy commissioner.

The estimated daily consumption of milk is 2,500 gallons, or 0.54 pint per capita; also 200 gallons of cream. Milk is sold from 8 stores and 45 wagons. About one-fifth of the milk is delivered in glass bottles, filled in the city, by 3 or 4 dealers.

One dairy during the hot months pasteurizes milk. The retail price of milk is 6 cents per quart in summer and 8 cents in winter, producers receiving 3¾ cents in the summer season. There are no "model dairies" near the city. Within the city limits there are 6 herds, including 200 cows. The longest shipment of milk to the city is 50 miles.

During the past year 650 samples of milk were examined by the Babcock test; all of the city herds but none of the dairy farms were inspected; and 1 cow was examined for tuberculosis.

WEST VIRGINIA.

Code of 1891, chapter 150, section 20, refers to foods. It is unlawful to sell any article of food or drink that is not what it is represented to be.

Wheeling. (Population, 38,878.)

[For comparison with other cities in Class III, see p. 38.]

S. L. Jepson, M. D., ex-health officer.

The daily consumption of milk is estimated as 4,000 gallons, or 0.82 pint per capita, besides a small quantity of skimmed milk and 400 gallons of cream. Milk is sold from 140 stores and 120 wagons. Glass bottles are not used to a very great extent in the delivery of milk. They are filled some at the farms and some in the city. Milk is pasteurized only when prescribed by physicians. The retail price of milk is 6 cents per quart in summer and 8 cents in winter, producers receiving 3 and 4 cents, respectively. There are no "model dairies" near the city. Within the city limits there are 10 herds, including 100 cows, and milk is sent in from 125 dairy farms. About one-third of the milk is received by railway, the longest shipment being 30 miles.

The city has no milk ordinance, and no supervision is exercised over its milk supply.

The health officer believes that all milk dealers should be licensed, a milk standard should be fixed, and dairies should be inspected by a city official.

WISCONSIN.

H. C. Adams, State dairy and food commissioner, Madison.

The dairy laws have been compiled and in 1899 they were published in 22 sections by the State dairy and food commissioner. It is the duty of that officer to enforce laws regarding dairy products. County district attorneys shall assist. Necessary authority is given for inspections, samples may be taken (duplicate to owner when requested), etc. It is unlawful to sell as pure any milk that is impure, adulterated, or unwholesome, including diluted or skimmed milk, milk from a cow known to be within fifteen days before or four days after parturition, or having ulcers, etc. And it is unlawful to sell milk that was handled in unclean vessels, or milk from cows that are diseased, kept in unsanitary conditions, or fed on unwholesome food, or refuse or slops from a distillery or vinegar factory, unless such slop "be mixed with other dry sanitary grain or food to a consistency of a thick mush;" or milk to which a preservative or any foreign substance has been added; but viscogen or sucrate of lime may be used to restore viscosity to pasteurized milk or cream if its use is made known. The milk standard is 3 per cent fat.

The sale of any adulterated food is prohibited, such an article being defined at length.

So far as its limited force permits, the dairy and food commission cooperates with local authorities in the supervision of the market milk supply. Last year State

authorities made examinations in Milwaukee, Wausau, Janesville, Madison, Watertown, Racine, Kenosha, and Merrill. A few years ago brief statements of conditions found at dairies were published in the commissioner's annual report. The statements relating to two dairies—a good one and a poor one (names of persons being here omitted)—are as follows:

Number of cows, 32; condition of stock, good, clean; condition of stables, clean; utensils, clean; feed, brewers' grains, corn feed, clover hay; well water. A good, clean dairy. Inspected (second visit) April 7, 1898.

Number of cows, 9; condition of stock, very dirty, manure on hips and belly; condition of stables, dirty; utensils not seen; feed, brewers' grains, middlings, and hay; city water. Sickness prevented proper care; so informed by proprietor. No improvement since March 29, 1898. Drainage poor. Inspected February 27, 1899.

The commissioner's report shows, also, that a large number of samples of milk delivered to butter and cheese factories, as well as to cities and towns, have been examined for fat content. A few bacteriological examinations have been made by the bacteriologist of the State University.

It is estimated that not 10 per cent of the milk sold is delivered in glass bottles and probably not more than 1 per cent of the total is pasteurized; this latter treatment is increasing. The average retail price of milk in cities and towns varies from 4 to 6 cents. Milwaukee is the only city in which any considerable portion of the milk supply is handled by middlemen, and the country producers supplying that city receive an average of about 2½ cents per quart for their milk.

Recent improvements in the milk supply are due to better dairy cattle, producing a higher grade of milk, and improved methods of caring for cows and handling milk.

Milwaukee. (Population, 285,315.)

[For comparison with other cities in Class I, see p. 28.]

W. C. Bennett, M. D., analyst.

The daily consumption of milk is estimated as 25,000 gallons, or 0.70 pint per capita, besides 600 gallons of cream and an unknown quantity of skimmed milk. Milk is sold from about 500 stores and 600 wagons. About one-tenth of the supply is delivered in glass bottles, and these are filled in the city. Trade in pasteurized milk is unimportant. The retail price of milk is 5 cents per quart in summer and 5 to 6 cents in winter, the producers receiving 2 cents in summer and 2½ cents in winter. There are no "model dairies" in or near the city. Within the city limits there are 117 dairy herds, including 643 head; the number of dairy farms sending milk into the city is unknown. About one-fourth of the entire supply is received by rail, the longest shipment being 72 miles.

An ordinance adopted by the city council October, 1891, requires that each person dealing in milk shall procure a license from the health commissioner who must first be satisfied with the sanitary condition of the dairy premises of the applicant; license fee, $1. Covered delivery wagons must be used during the entire year. Adulterated and skimmed milk, milk from cows fed on distillery waste or other unwholesome food, milk from any place where there is a contagious disease, or milk from tuberculous cows, is prohibited. The use of wholesome brewers' grains is allowed. The milk standard is 12 per cent solids, 9 per cent solids not fat. Inspectors are authorized to pour illegal milk upon the ground. Skimmed milk may be sold, if in vessels plainly labeled; it must contain 9 per cent solids not fat.

The ordinance section requiring covering on milk delivery vehicles is shown in Appendix I (p. 179).

About $1,500 is expended annually in the supervision of the city milk supply, the entire time of no one officer being given to this work. During the past year a large number of samples of milk were examined for fat content by the Babcock test; no

samples were examined bacteriologically; 70 of the 117 herds within the city limits were inspected; none of those out of the city were inspected.

There has been a slight improvement in the composition and cleanliness of milk. Needed improvements include the application of the tuberculin test, so far as practicable; a municipal milk farm and laboratory to produce milk for infants' use; more perfect control of the sanitary conditions at the dairies outside of the city limits; more economical delivery, and an intelligent enforcement of the milk laws and ordinances.

Superior. (Population, 31,091.)

[For comparison with other cities in Class III, see p. 38.]

J. M. Ruggles, secretary of the board of health.

Milk is sold from 2 stores and about 40 wagons. About 27 herds, including over 400 cows, are within the city limits, and milk is sent in from dairy farms as far distant as 140 miles form the city.

Board of health ordinances, sections 47 to 52, refer to milk. License fee for sale of milk is 50 cents for each store and each wagon. Adulterated, etc., milk is prohibited. The milk standard shall from time to time be fixed by the board of health, but is subject to change by the common council.

The meat and milk inspector's monthly report is published in the city papers, and shows the names of dairymen visited, the number of cows kept by them, the per cent of fat in their milk, the kinds of feed used, the source of water supply, and the general appearance of the stock and barns.

Racine. (Population, 29,102.)

[For comparison with other cities in Class III, see p. 38.]

Fred Pfister, health officer.

The estimated daily consumption of milk is 1,800 gallons, or 0.49 pint per capita, besides 100 gallons of skimmed milk and 50 gallons of cream. Milk is sold from 20 stores and 40 wagons. About 15 per cent of the milk supply is delivered in glass bottles filled at the farms, but none is pasteurized. The retail price of milk is 5 cents per quart throughout the year, producers being paid 2½ cents. There are no dairy herds within the city limits. Milk is brought in wagons from 50 dairy farms, the longest haul being 8 miles.

The city expends nothing in the supervision of its milk supply. During the past year 10 samples were examined by the Babcock test, lactometer, and pycnometer; no bacteriological examinations were made, and none of the dairy herds were inspected.

It is said that several well-conducted dairies near the city, supplying milk to a proprietary food company, have by their example assisted in bringing about improvements in other dairies.

La Crosse. (Population, 28,895.)

[For comparison with other cities in Class III, see p. 38.]

Richard D. Murphy, health officer.

The daily consumption of milk is estimated as 1,000 gallons, or 0.28 pint per capita, besides 100 gallons of skimmed milk and 100 gallons of cream. Milk is sold from 50 stores and 30 wagons. Five per cent of the milk is delivered in glass bottles filled at the farms. None is pasteurized. The retail price of milk is 5 cents per quart throughout the year. The milk from one "model dairy" is sold for 6 cents per quart. Milk is sent in from 16 dairy farms, all within 1½ miles of the city.

The city exercises no supervision over its milk supply.

Oshkosh. (Population, 28,284.)

No reply to inquiries was received.

Greenbay. (Population, 18,684.)

[For comparison with other cities in Class IV, see p. 42.]

F. H. Thibodo, health officer.

The daily consumption of milk is estimated as 600 gallons, or 0.26 pint per capita, besides 60 gallons of cream. In explanation of this apparently low consumption it is stated that a great many families keep their own cows, and the milk from these is not included in the above estimate. Milk is sold from 1 store and 28 wagons. Several dairymen deliver milk in glass bottles, and these are filled at the farms. The retail price is 5 cents per quart throughout the year, producers receiving 3 cents. There are no "model dairies" near the city. Within the city limits there are 8 herds, including 120 cows, and milk is brought in wagons as far as 8 miles.

Ordinance of June, 1894, and board of health rules, March, 1894, sections 10 to 17, refer to milk. License fee for the sale of milk is $2, but persons keeping 1 or 2 cows in the city are exempt. Delivery wagons must be covered from April 1 to December 1. Impure, adulterated, etc., milk is prohibited. The standard is 12 per cent solids, 9 per cent solids not fat. Skimmed milk must be labeled and contain 9 per cent solids not fat. Cows must be given wholesome food and water. Employees must be free from contagious disease. Dairy premises and apparatus must be kept clean. Milk tickets must not be taken from a place where a contagious disease exists.

The health department has supervision over the milk supply. During the past year 12 samples of milk were examined by lactometer and Babcock test and doubtful samples by gravimetric analysis; no bacteriological examinations were made; all the city herds and 20 dairy farms were inspected.

Recent improvement in the quality of the milk is due to a better grade of cows.

Marinette. (Population, 16,195.)

[For comparison with other cities in Class IV, see p. 42.]

T. J. Redelings, health commissioner.

The daily consumption of milk is estimated as 464 gallons, or 0.23 pint per capita, besides 12 gallons of cream. In explanation of this low consumption of milk it is stated that about 200 cows are kept by private families, and the milk from these is not included in the above estimate. Milk is sold from 3 stores and 23 wagons. Very little of it is delivered in glass bottles, and these are filled at the farms. Some families pasteurize their own milk supply. The retail price of milk is 5 cents per quart in summer and 6 cents in winter, producers selling their own product. There are no "model dairies" near the city. Within the city there are 8 herds, including 105 cows, and milk is sent in from 15 dairy farms (237 cows). About one-tenth of the supply is received by railway, the longest shipment being 96 miles.

Ordinance No. 117, July, 1901, having 26 sections, refers to milk. License fee for the sale of milk or cream is $1 for each wagon, store, etc.; each wagon after the first, $1. Licenses are issued only after the health commissioner is satisfied with the sanitary conditions of the dairy premises. Impure, adulterated, etc., milk is prohibited. The milk standard is 12 per cent solids, 9 per cent solids not fat. Skimmed milk must be labeled and contain 9 per cent solids not fat. Sour milk must be labeled. Milk vehicles must be covered from April 1 to December 1. Stables must be whitewashed once a year. Cows must be fed upon wholesome food and be given pure water; be inspected in January, July, and September of each year; and every April they must be tested with tuberculin. The ordinance includes 15 rules regard-

ing the management of dairies. Milk tickets must not be taken from places where there is a contagious disease, and the commutation, or punch, ticket must be used.

The health commissioner supervises the milk supply. During the past year 82 samples were examined by lactometer and Babcock test. No bacteriological examinations were made. All the city herds and all the dairy farms were inspected. Of 105 cows voluntarily subjected to the tuberculin test, 6 reacted and were killed by State officers.

Recent improvement is due to cleanliness at stables and the prompt cooling of milk. Needed improvements as given include the establishment of sterilizing stations for all milk, the use of the tuberculin test for all cows, and the spreading of information relating to the care of dairies.

Waukesha. (Population, 7,419.)

[For comparison with other cities in Class IV, see p. 42.]

Hugo Philler, M. D., health commissioner.

The daily consumption of milk is estimated as 395 gallons, or an average of 0.43 pint per capita. Milk is sold from 15 wagons, and about one-fifth of it is delivered in glass bottles. Very little milk is pasteurized, and the practice is not increasing. The retail price is 6 cents per quart throughout the year. Within the city limits there are 2 herds, including 40 cows, and milk is sent in from 13 dairy farms within 3 miles of the city limits.

About $150 is expended annually toward the supervision of the milk supply as the salary to the health commissioner. During the past year 350 samples of milk were examined by lactometer and Babcock test, special attention being given to preservatives; and 3 samples were examined bacteriologically for tubercle bacilli.

WYOMING.

Revised statutes, 1899, sections 2644, 5109, and 5110, refer to milk and foods. Milk is exempted from the list of articles that can not be sold on Sundays. The adulteration of any article of food or drink with fraudulent intent or sale of same or knowingly selling any unwholesome article of food or drink is a misdemeanor.

APPENDIX 1.

The following are the milk ordinances entire of six cities, and miscellaneous selected sections from numerous others:

New York City.

The following are sections from the Sanitary Code, and regulations and rules as published by the board of health of the city of New York:

EXTRACT FROM SANITARY CODE OF LAWS GOVERNING THE SALE OF MILK.

SECTION 59. That no person shall have at any place where milk, butter, or cheese is kept for sale, nor shall at any place, sell, deliver, or offer, or have for sale, or keep for use, nor shall any person bring or send to said city any unwholesome, skimmed, watered, or adulterated milk, or milk known as "swill milk," or milk from cows or other animals that for the most part have been kept in stables or that have been fed in whole or in part on swill, or milk from sick or diseased cows or other animals, or any butter or cheese made from any such milk, or any unwholesome butter or cheese.

SEC. 63. No milk which has been watered, adulterated, reduced, or changed in any respect by the addition of water, or other substance, or by the removal of cream, shall be brought into, held, kept, or offered for sale at any place in the city of New York, nor shall anyone keep, have, or offer for sale in the said city any such milk.

The term "adulterated," when so used in this section, means:

First. Milk containing more than 88 per cent of water or fluids.

Second. Milk containing less than 12 per cent of milk solids.

Third. Milk containing less than 3 per cent of fats.

Fourth. Milk drawn from animals within fifteen days before or five days after parturition.

Fifth. Milk drawn from animals fed on distillery waste, or any substance in a state of fermentation or putrefaction, or on any unhealthy food.

Sixth. Milk drawn from cows kept in a crowded or unhealthy condition.

Seventh. Milk from which any part of the cream has been removed.

Eighth. Milk which has been adulterated with water or any other fluid, or to which has been added, or into which has been introduced, any foreign substance whatever.

SEC. 64. Any milk found to be adulterated, either by the addition of water or other substances, or by the removal of cream, or which has been brought into, or is held or offered for sale in the city of New York contrary to the provisions of section 63 of the Sanitary Code, may be seized and destroyed by any inspector, or other officer of this department authorized to inspect milk.

SEC. 65. No condensed milk which is adulterated shall be brought into, held, kept, or offered for sale at any place in the city of New York, nor shall anyone have, keep, or offer for sale in said city any such condensed milk. The words "condensed milk" mean pure milk from which any part of the water has been removed, or pure milk from which any part of the water has been removed and to which sugars have been added. The term "adulterated," when used in this section, refers to condensed milk in which the amount of fat is less than 25 per cent of the milk solids contained therein, or to which any foreign substance whatever has been added, excepting sugars, as in preserved milks.

SEC. 66. No milk shall be received, held, kept, offered for sale, or delivered in the city of New York without a permit in writing from the board of health and subject to the conditions thereof.

SEC. 67. No cream that is adulterated shall be brought into, held, kept, or offered for sale in the city of New York, nor shall anyone keep, have, or offer for sale in said city any such cream. The term "cream" means the fatty portions of pure milk which rise to the surface when the milk is left at rest, or which is separated by other means. The term "adulterated," when used in this section, refers to cream to which any foreign substance whatever has been added.

REGULATIONS.

(1) Milk shall not be kept for sale or stored in any room used for sleeping or domestic purposes or opening into the same.

(2) Milk must not be transferred from cans to bottles or other vessels on streets or on ferries or at depots, except when transferred to vessel of purchaser at time of delivery.

(3) Milk shall not be sold in bottles except under the following rules:

Bottles must be washed clean with a hot water solution of soap, or soda, or some other alkali, and then with hot water before filling with milk.

Bottles must not be filled except at the dairy or creamery, and in the city only in rooms so situated as to prevent the contamination of the milk by dust from the streets or other impurities.

Bottles must not be washed or filled with milk in any room used for sleeping or domestic purposes or opening into the same.

(4) The vessel in which milk is kept for sale must be so protected by means of a suitable cover or covered receptacle and so placed in the store as to prevent dust from the street or other impurities falling into it.

(5) Store permits must be posted in stores so that they can be easily seen at all times.

(6) Wagon permits to be carried on the wagons at all times when engaged in the sale, transportation, or delivery of milk.

(7) The number of wagon and the number of permit, the latter to be preceded by the words "Department of Health Permit," must be painted on both sides of the wagon in letters 2 inches in length and one-half inch in width, and in some contrasting color to that of the wagon.

(8) If any changes are made in the information given on application blank, the department must be immediately notified.

RULES FOR HANDLING AND KEEPING MILK.

(1) Milk should be kept in some place where dust and other impurities can not fall into it, such as a box with tight-fitting cover—preferably an ice box.

(2) The milk should be kept at as low a temperature as possible, not above 50° F.

(3) After the day's sales are over, the measures and utensils used in the sale of milk should be thoroughly cleaned with boiling water, to which a small amount of soda has been added in the proportion of one tablespoonful of washing soda to a gallon of water.

(4) The overflow pipe from the ice box in which the milk is kept must not be connected directly with the drainpipe or sewer, but must discharge into an open, water-supplied, properly-trapped, sewer-connected sink. (See section 41 of the Sanitary Code.)

(5) The ice box in which the milk is kept should be cleaned, by scrubbing out with hot soda solution made as in No. 3, at least twice a week.

(6) In selling milk, stir up the contents of the can thoroughly before measuring out the amount desired. This will prevent unintentional skimming. In this way the last quart of milk sold from the can will contain as much cream as the first quart sold.

(7) It sometimes happens that in cold weather the milk may be delivered to the dealer more or less frozen. If such is the case, detach the ice from the side of the can and gently heat the contents until the ice is all melted. If there is much ice in the can it is absolutely necessary to do this before selling the milk, otherwise the liquid part dipped out and sold at first will contain more of the solid part of the milk and cream, while the ice remaining and consisting principally of water will after a time melt, and the result will be milk containing more water than pure milk, and this might be enough to appear as though the milk had been adulterated with water.

(8) Do not place ice in the milk if it is desired to cool it or keep it cold, as the ice will melt and you will then have adulterated the milk with water.

City of Washington, D. C.

REGULATIONS FOR THE GOVERNMENT OF DAIRIES AND DAIRY FARMS.

OFFICE COMMISSIONERS OF THE DISTRICT OF COLUMBIA,
Washington, July 31, 1897.

Ordered, That the following regulations made by the health officer of the District of Columbia, pursuant to the requirements of section 11 of "An act to regulate the sale of milk in the District of Columbia, and for other purposes," approved March 2,

1895, in lieu of the regulations on the same subject made and approved June 20, 1895, are hereby approved:

SECTION 1. No building or space shall be used for dairy purposes which is not well lighted and ventilated, which is not provided with a suitable floor, and, if such room or space be a cellar or subcellar, or be located in a cellar or subcellar, which is not properly concreted, guttered, and drained.

SEC. 2. No dairy shall be located or maintained within any kitchen, wash room, work shop, or inhabited room, nor in proximity to any water-closet, privy, cesspool or urinal, nor in any room or space which is not of such size and construction as to permit the entire separation of all milk and milk products, both in the process of handling and storing the same, from all probable sources of contamination, either by dirt, noxious gases, infective organisms, or substances or anything liable to alter unnecessarily the quality of such milk or milk products.

SEC. 3. Every person maintaining a dairy shall provide for the use thereof, and shall use, a sufficient number of receptacles, made of nonabsorbent material, for the reception, storage, and delivery of milk, and shall cause them to be kept clean and wholesome at all times; and having delivered any such receptacle to a consumer shall not again use the same for the reception, storage, or delivery of milk or cream in any form until it has been, to his personal knowledge, properly cleaned after such use.

SEC. 4. Every person maintaining a dairy shall provide for the use thereof a supply of pure and suitable water, sufficient for the proper washing of all cans, bottles, and appliances.

SEC. 5. Every person maintaining a dairy shall keep the same and all appurtenances thereto clean and wholesome at all times, and shall change the water in the coolers at least once each day.

SEC. 6. No building shall he used for stabling cows for dairy purposes which is not well lighted, ventilated, drained, and constructed, or which is not provided with stalls or with proper stanchions for anchoring the cows so arranged as to allow not less than three and one-half feet width of space for each milch cow; or which is not provided with good and sufficient facilities for feeding the animals in a cleanly manner; or which contains less than six hundred cubic feet clear space for each cow, unless the use of such building for stabling cows for dairy purposes has been authorized prior to the promulgation of these regulations, in which case it shall contain not less than five hundred cubic feet clear air space for each cow.

SEC. 7. No room shall be used for stabling cows for dairy purposes which contains any water-closet, privy, cesspool, urinal, or manure pit; nor shall any fowl, hog, horse, sheep, or goat be kept in any room used therefor.

SEC. 8. Every person using any premises for keeping cows for dairy purposes shall, when so directed by the health officer, erect and maintain in the stable, stall, shed, or yard connected therewith one or more proper receptacles for drinking water for such cows, and shall keep the same supplied with clean, fresh water and none other.

SEC. 9. Every person using any premises for keeping cows for dairy purposes shall keep the entire premises clean and in good repair and the buildings well painted or whitewashed.

SEC. 10. Every person using any premises for keeping cows for dairy purposes shall cause the dung to be removed from the stables at least twice daily, and always within one hour preceding every milking of the cows; and shall not allow any accumulation of dung within the building occupied by the cows, but shall, whenever in the opinion of the health officer it is required by local conditions and surroundings, provide temporary storage for the same and for other refuse in a separate place, which shall be covered, and which, when so ordered by said health officer, shall be a water-tight receptacle.

SEC. 11. Every person keeping cows for dairy purposes within the city of Wash-

ington or its more densely populated suburbs, or elsewhere in the District of Columbia, if, in the opinion of the health officer, local conditions require it, shall cause the inclosure in which such cows are kept to be graded and drained so as to keep the surface reasonably dry and to prevent the accumulation of water therein, except as may be permitted for the purpose of supplying drinking water; and shall not permit any garbage, urine, fecal matter or similar substance to be placed or to remain in such inclosure, nor any open drain to run through it.

SEC. 12. Every person keeping cows for the production of milk for sale shall cause them to be kept clean and wholesome at all times, and shall cause the teats, and, if necessary, the udder, to be carefully cleaned by brushing, washing, or wiping before milking, and shall cause each such cow to be properly fed and watered.

SEC. 13. Any person using any premises for keeping cows for dairy purposes shall provide and use a sufficient number of receptacles, of nonabsorbent material, for the reception, storage, and delivery of milk, and shall keep them clean and wholesome at all times, and at milking time shall remove each receptacle, as soon as filled, from the stable or room in which the cows are kept; nor shall any milk or cream be stored or kept within any room used for stabling cows or other domestic animals.

SEC. 14. It shall be the duty of every person having charge or control of any premises upon which cows are kept to notify the health officer of the District of Columbia of the existence of any contagious or infectious disease among such cows, by letter delivered or mailed, within twenty-four hours after the discovery thereof, and to thoroughly isolate any cow or cows so diseased or which may reasonably be believed to be infected, and to exercise such other precautions as may be directed, in writing, by said health officer.

SEC. 15. Milkers and those engaged in the handling of milk or cream shall maintain strict cleanliness of their hands and persons while milking and while so engaged. It shall be the duty of every person holding a permit to maintain a dairy or dairy farm to enforce this regulation in reference to such persons as may assist them in the maintenance thereof.

SEC. 16. That any person violating any of the foregoing regulations shall, on conviction thereof in the police court, be punished by a fine of not more than ten dollars for each and every such offense, to be collected as other fines and penalties are collected.

SEC. 17. That the regulations for the government of dairies or dairy farms in the District of Columbia promulgated June 26, 1895, are hereby repealed.[a]

Louisville, Ky.

Be it ordained by the general council of the city of Louisville:

SECTION 1. That no person shall bring or send into the city for sale any milk without a permit to do so from the health officer, said permit to be furnished gratuitously by the health officer to all applicants, and to be renewed in the month of January of each year to be valid.

SEC. 2. All milk wagons shall have the name of the owner and the number of the wagon or vehicle painted thereon plainly and legibly.

SEC. 3. All grocers, bakers, and other persons having or offering for sale milk shall at all times keep the name or names of the dairyman or dairy company from whom the milk for sale was obtained posted up in a conspicuous place wherever such milk may be sold or kept for sale.

SEC. 4. No milk which is unwholesome or which has been watered, adulterated, reduced, or changed in any respect by the addition of water or other substance, or by the removal of cream, shall be brought into, held, kept, or offered for sale at any

[a] The milk and food laws of the District of Columbia are published in full on pages 576–581 of the Fourteenth Annual Report of the Bureau of Animal Industry.

place in the city of Louisville, nor shall anyone keep, have, or offer for sale in the said city any such milk, except as provided for in this ordinance.

SEC. 5. The terms "adulterated or unwholesome," as used in this ordinance, are held to mean in this ordinance:

First. Milk containing more than 88 per centum of water or fluids.

Second. Milk containing less than 12 per centum of milk solids.

Third. Milk containing less than 3 per centum of fats or having a specific gravity of less than 1.029.

Fourth. Milk drawn from animals within fifteen days before or ten days after parturition.

Fifth. Milk drawn from animals fed on distillery waste, or any substance in a state of fermentation or putrefaction, or on any unhealthy food or drink.

Sixth. Milk drawn from cows kept in a crowded or unhealthy condition.

Seventh. Milk from which any part of the cream has been removed.

Eighth. Milk which has been adulterated with water, or any other fluid, or to which has been added, or into which has been introduced, any foreign substance whatever.

Ninth. Cream sold or offered or kept for sale as such must contain at least 20 per centum butter fat.

SEC. 6. No dealer in milk, by himself or his agents, shall sell, or have in his possession with intent to sell, milk from which cream has been removed in part or in whole, unless sold as skimmed milk, and unless there shall appear in a conspicuous place on both sides of the vehicle from which such milk is sold the words "Skimmed milk," distinctly and legibly made in letters not less than 1 inch in height; nor shall any dealer in milk, nor his agent or agents, sell as skimmed milk any milk which has a less percentage of casein and salts than that contained in unskimmed milk.

SEC. 7. Every dealer in milk selling such skimmed milk shall, on each and every vessel from which he sells, have attached in front and side a notice stating in legible letters that such skimmed milk is for sale.

SEC. 8. Any person who offers for sale milk, skimmed or unskimmed, in the city of Louisville, whether a resident or nonresident, shall furnish a sample of such milk to any officer representing the health department of the city of Louisville who may request the same for the purpose of examination or analysis.

SEC. 9. No dealer in milk, or his agents, shall serve milk in bottles to any dwelling or other house that has in it any contagious disease or diseases, or that is placarded by the health officer for contagious disease or diseases, until said placard has been removed by the proper authorities; nor shall any person remove from such dwelling or house any bottle or receptacle which has been or is used for the purpose of receiving or storing milk. No person suffering from, or who has knowingly, within a period of twenty days, been exposed to, diphtheria, scarlet fever, erysipelas, smallpox, or other dangerous contagious disease, shall work or assist in or about any dairy or dairy farm; no proprietor, manager, or superintendent of any dairy or dairy farm who supplies milk to the citizens of Louisville, Ky., shall knowingly permit any person suffering, or exposed as aforesaid, to work or assist in or about said dairy or dairy farm.

SEC. 10. The health officer shall not issue a permit to any person to sell milk in the city of Louisville who does not furnish once in every three months the health department with a certificate from a duly qualified veterinary surgeon to the effect that the cattle from which the milk he proposes to sell is obtained are entirely free from disease, and said certificates shall be kept on file in the health department, and shall embrace a descriptive enumeration of the cattle examined. The health officer may require the tuberculin test if any herd is suspected of infection with tuberculosis.

SEC. 11. Every person maintaining a dairy shall keep the same and all appurte-

nances thereto clean and wholesome at all times, and shall change the water in the coolers at least once in each day, and no building or space shall be used for dairy purposes which is not well lighted and ventilated and which is not provided with a suitable floor and properly drained, or which contains less than 600 cubic feet clear space for each cow.

SEC. 12. Every person using premises for keeping cows for dairy purposes shall keep the entire premises clean and in good repair and the buildings well painted or whitewashed, and no accumulation of dung shall be allowed, but shall be removed at least twice daily, and one hour preceding every milking of the cows.

SEC. 13. Milkers and those engaged in the handling of milk or cream shall maintain strict cleanliness of their hands and persons while milking or while so engaged.

SEC. 14. Every person keeping cows for the production of milk for sale shall cause them to be kept clean and wholesome at all times, and shall cause the teats, and, if necessary, the udder, to be carefully cleaned by brushing, washing, or wiping before milking, and sha'l cause each of such cows to be properly fed and watered.

SEC. 15. Any person using any premises for keeping cows for dairy purposes shall provide and use a sufficient number of receptacles of nonabsorbent material for the reception, storage, and delivery of milk, and shall keep them clean and wholesome at all times, and at milking time shall remove each receptacle as soon as filled from the stable or room in which the cows are kept; nor shall any milk or cream be stored or kept within any room used for stabling cows or other domestic animals.

SEC. 16. It shall be the duty of every person having charge or control of any premises upon which cows are kept to notify the health officer of the city of Louisville, of the existence of any contagious or infectious disease among such cows, by letter delivered or mailed within twenty-four hours after the discovery thereof, and to thoroughly isolate any cow or cows so diseased, or which he may reasonably believe to be infected, and to exercise such other precautions as may be directed, in writing, by said health officer.

SEC. 17. All dairies from which milk is offered for sale in the city of Louisville shall be open at all times to the inspection of the health officer of the city of Louisville, or any officer representing him.

SEC. 18. That any person, firm, company, or corporation who shall violate any of the provisions of this ordinance shall be fined for each offense not less than $20 nor exceeding $100.

SEC. 19. This ordinance shall take effect from and after its passage.

Indianapolis, Ind.

RULES AND REGULATIONS FOR THE CARE AND MANAGEMENT OF DAIRIES ADOPTED BY THE BOARD OF PUBLIC HEALTH AND CHARITIES.

(1) No building shall be used for stabling cows for dairy purposes which is not well lighted, ventilated, drained, and constructed.

(2) No building shall be used for stabling cows for dairy purposes which is not provided with a suitable floor, laid with proper grades and channels to carry off all drainage. If a public sewer abuts the premises upon which such buildings are situated, they shall be connected therewith and furnished with proper sanitary traps.

(3) No building shall be used for stabling cows for dairy purposes which is not provided with good and sufficient feeding troughs or boxes, and with a covered watertight receptacle outside the building for the reception of dung or other refuse.

(4) No water-closet, privy, cesspool, urinal, inhabited room, or workshop shall be located within any building or shed used for stabling cows for dairy purposes or for the storage of milk or cream; nor shall any fowl, hog, horse, sheep, or goat be kept in any room used for such purpose.

(5) No space in buildings or sheds used for stabling cows shall be less than 500 cubic feet for each cow, and the stalls therefor shall not be less than 4 feet in width.

(6) It shall be the duty of each person using any premises for keeping cows for dairy purposes to keep such premises thoroughly clean and in good repair and well painted or whitewashed at all times.

(7) It shall be the duty of each person using any premises for keeping cows for dairy purposes to cause the building in which cows are kept to be thoroughly cleaned and to remove all dung from the premises, so as to prevent its accumulation in great quantities.

(8) Every person keeping cows for the production of milk for sale shall cause every cow to be cleaned every day and to be properly fed and watered.

(9) Every person using any premises for keeping cows shall cause the yard used in connection therewith to be provided with a proper receptacle for drinking water for such cows; none but fresh, clean water to be used in such receptacle.

(10) Any inclosure in which cows are kept shall be graded and drained so as to keep the surface reasonably dry and to prevent the accumulation of water therein, except as may be permitted for the purpose of supplying drinking water; no garbage, urine, fecal matter, or similar substances shall be placed or allowed to remain in such inclosure, and no open drain shall be allowed to run through it.

(11) Any person using any premises for keeping cows for dairy purposes shall provide and use a sufficient number of receptacles, made of nonabsorbent materials, for the reception, storage, and delivery of milk, and shall cause all milk to be removed without delay from the room in which the cows are kept.

(12) No milk shall be kept in ice boxes or refrigerators which are in any way connected with sewers or cesspools, nor shall any milk be kept in the same compartment of any ice box or refrigerator in which meats or other articles of food are kept.

(13) All cans, measures, and other receptacles for milk shall be scalded with boiling water or live steam daily; they must not be rinsed in cold water before using, for the water may not be pure, and some of it remaining in the vessels may contaminate the milk. All milk cans coming from dairies to dealers must be properly cleaned as above before returning to producer, thoroughly aired, and kept turned upside down in a cool place.

(14) All milk shall be strained through wire-cloth strainers and shall be cooled to 58° within forty-five minutes after it is drawn from the cow. In winter weather said cooler shall be guarded against freezing. The milk shall not exceed 60° when delivered to the consumer or dealer.

(15) All milk cans delivered to creameries or dealers in the city shall be covered with air-tight lids, and when conveyed in open wagons shall be covered with canvas while being so conveyed; said canvas to be kept clean by frequent washing.

(16) All stripping, as well as first part of milk, shall be delivered. The night's and morning's milk shall not be mixed. No milk shall be delivered that is taken from a cow that has calved within twelve days or from a cow that will come in or calve inside of sixty days.

(17) Cows shall not be fed on feed which will impart a disagreeable flavor to milk or upon any food which will not produce milk of a standard richness, or any sour, damaged feed or ensilage.

(18) It shall be the duty of any person having charge or control of any premises upon which cows are kept to notify the secretary of the board of health of the existence of any contagious or infectious disease among such cows immediately upon the discovery thereof, and to thoroughly isolate any cow or cows affected, and to exercise such other precautions as may be directed, in writing, by the said secretary.

(19) It shall be the duty of any person owning or having control of cows used for the production of milk for sale or exchange to submit said cows to the tuberculin test for tuberculosis on the written order of the secretary of the board of health.

(20) It shall be the duty of any person having charge or control of any premises upon which milk or cream is produced, handled, stored, or distributed to notify the secretary of the board of health immediately upon the discovery of any case of

Asiatic cholera, croup, diphtheria, measles, membranous croup, scarlet fever, smallpox, typhoid fever, typhus fever, or any other contagious or infectious diseases upon such premises. No milk or cream shall be sold, exchanged, given away, or in any other manner distributed from such infectious premises until all danger of spread of disease shall be removed and the secretary certifies to that effect. No person who attends cows or milks them, or who has the care or handling of vessels for the sale, storage, or distribution of milk or cream, shall enter any place or premises wherein exists any of the diseases mentioned herein; nor shall any such have any communication, direct or indirect, with any person who resides in or is an occupant of such infected place. Strict cleanliness of the hands and person of milkers and those engaged in the handling of milk or cream, and of the bodies of cows, especially of the udders and teats, must be enforced at all times, to the end that no impurity or foreign substance may be added to the milk or cream, such addition being declared adulteration by the statute.

(21) No person shall add water or any other foreign substances to milk or cream offered or intended for sale or exchange. Milk offered for sale as whole milk or sold as such which contains more than 87 per cent of watery fluid or less than 13 per cent of milk solids, including 3.7 per cent of butter fat,[a] is prima facie watered, and such watering is declared an adulteration by the ordinance, the punishment for which is a fine of not less than $25 for each and every offense.

Memphis, Tenn.

MILK ORDINANCE.[b]

Be it ordained by the legislative council of the city of Memphis, That—

SECTION 1. No milk, buttermilk, or cream, or other dairy products shall be received, held, kept, offered for sale, or delivered in the city of Memphis without [the dealer] first obtaining a permit in writing from the board of health, and subject to the conditions thereof.

SEC. 2. No person shall have at any place, sell, deliver, or offer for sale, or keep for use, or bring or send to said city, milk or other dairy products which are unwholesome or adulterated with any substance, or from diseased animals, or from animals which are kept in uncleanly and unsanitary stables or stable yards, or from animals which are fed on distillery waste or other unwholesome food, or watered with polluted water, or from dairy farms or other places where attendants are affected with or exposed to contagious or infectious diseases.

SEC. 3. Milk shall be termed unwholesome—

(*a*) When drawn from animals within fifteen days before or five days after parturition.

(*b*) When drawn from animals fed on distillery or other unhealthy food or watered with polluted water.

(*c*) When drawn from animals kept in a crowded or in unhealthy conditions.

(*d*) When obtained from dairy farms or other places where attendants are affected with or exposed to contagious or infectious diseases.

SEC. 4. Milk shall be termed adulterated—

(*a*) When it contains more than 88 per cent of water or other fluid.

(*b*) When it contains less than 12 per cent of milk solids.

(*c*) When it contains less than 3 per cent of fats.

(*d*) When water, or antiseptic, or other substance has been added.

(*e*) When any part of the cream has been removed.

(*f*) When placed in containers which are dirty or have been washed with polluted water.

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[a] The milk standard has been lowered by a State law to 12 per cent solids, 3 per cent fat.—H. E. A.

[b] This ordinance is printed on the reverse side of the milk license.

SEC. 5. It shall be the duty of the sanitary officers to obtain samples of milk, buttermilk, or cream from milk dealers whenever requested to by any citizen or ordered to do so by the board of health; said samples, together with name and address of dealers or drivers, are to be sent to the city chemist for analysis.

SEC. 6. All wagons shall have painted thereon, in plain, legible manner, the name of the dairy or owner thereof and the number of the wagon; and anyone selling or offering for sale milk, cream, or buttermilk without having a permit, as provided for herein, or selling or offering for sale milk, cream, or buttermilk, or other dairy product which is unwholesome or adulterated, or in any way violating, as a whole or in part, the provisions of this ordinance within said city, shall be guilty of misdemeanor and subject the offenders to a fine of not less than $5 nor more than $50 for each and every offense.

This ordinance shall take effect from and after its passage.

Passed July 13, 1898.

Erie, Pa.

RULES AND REGULATIONS OF THE BOARD OF HEALTH CONCERNING THE MILK SUPPLY.

SECTION 1. No person or persons shall sell milk or cream in the city of Erie without first, annually before the 1st day of July, registering with the board of health his or their name or names, together with the location of their route or place of business and the name of the owner of and the location of the dairy from which they obtain said milk or cream, and obtaining from the board a permit to carry on such business, which permit shall be issued without charge and shall be displayed in every store or wagon from which said milk or cream is sold.

SEC. 2. Every person or persons peddling milk or cream in the city of Erie shall have the wagon or other vehicle from which milk is sold inclosed and conspicuously marked with his, her, or their names and the locality from which said milk or cream is obtained.

SEC. 3. No milk shall be sold, offered for sale, or distributed in the city of Erie unless the cows from which it is obtained have within one year been examined by a competent veterinarian and shown to the satisfaction of the board of health to be free from disease; but this does not necessarily mean that the tuberculin test must be employed.

SEC. 4. The quality of milk or cream offered for sale in this city shall be the same as is provided for by act of assembly, and skimmed milk shall not be sold except in the manner prescribed by such act.

SEC. 5. No milk or cream shall be sold by any person or persons in whose family or residence there is a case of contagious or infectious disease or from any dairy in the vicinity of which there is such disease, except by permission of and in the manner prescribed by the board.

SEC. 6. No milk shall be sold or exposed for sale in the city of Erie except milk sold from cows stabled under light, dry, and well-ventilated conditions, and in all other respects conforming to the requirements set forth in the following rules:

Rule 1. Each cow shall have at least 3 feet in width of floor space when fastened in stanchions, and, in all cases where no adequate artificial means for ventilation are provided, each animal shall have an air space of at least 500 cubic feet.

Rule 2. All stables for shelter of said cattle shall be provided with a tight, dry floor. The manure drop shall be water-tight, and if constructed of wood shall be asphalted, tarred, or otherwise made nonabsorbent.

Rule 3. The walls and ceilings of said stables shall be whitewashed whenever it may be deemed necessary by the board of health.

Rule 4. Manure shall not be allowed to accumulate in large quantities in stable yards nor near the buildings where the cattle are kept, and when stored temporarily in such places it shall be removed at least once a month to a distance of at least 10

feet from said stable. The stable yards shall be drained and kept in a clean, dry condition, and no accumulation of household garbage, vegetables, or other putrescible matter shall be allowed to remain or decay in said stable yards.

Rule 5. Cattle shall at all times be kept in a clean condition, and udders shall be washed, hand-rubbed or wiped with a clean, damp cloth before each milking.

Rule 6. No milk shall be sold or offered for sale or distributed in the city of Erie obtained from any cow that has calved within five days, or from a cow which will come in or calve within sixty days.

SEC. 7. No milk shall be sold or exposed for sale in the city of Erie except milk obtained from cattle fed and watered under the following conditions: All food given to such cattle shall be good and wholesome. Water supplied to cattle shall be pure and free from all contamination by stable or household drainage.

SEC. 8. All milkers and other attendants employed in any dairy the milk from which is to be sold or offered for sale or delivered in the city of Erie shall be personally clean. Before milking or caring for the milk hands shall be washed and clothes changed or brushed, and no milk shall be delivered or sold or exposed for sale in said city produced from dairies wherein the foregoing regulations are not observed.

SEC. 9. No milk shall be kept for sale or distribution or handled, transferred from can, or stored in any stable or similar place, or in any room used wholly or in part for domestic or sleeping purposes.

SEC. 10. Milk shall be stored or regularly mixed, cooled, or poured from can to can only in a room not directly connected with a stable or stables, provided with a tight floor, and kept constantly neat and clean, the walls of the room being of such a nature as to allow easy and thorough cleaning.

SEC. 11. No animal, water-closet, or privy shall be in the aforesaid room or in any room connected directly therewith.

SEC. 12. Whenever milk is filtered or strained, cooled, or stored in a room, said room shall be such as is described in sections 9 and 10.

SEC. 13. Milk kept for sale in any store, shop, market, bakery, or other establishment shall be always kept in a covered cooler, box, or refrigerator, properly drained and cared for; and while therein shall be tightly corked or closed, and only in such location and under such conditions as shall be approved by the board of health.

SEC. 14. All vehicles from which milk or cream is sold in this city shall, during the months of June, July, August, and September, be equipped with ice boxes, which shall be kept clean and which shall be of sufficient size.

SEC. 15. All cans, bottles, or vessels of any sort used in the sale, delivery, or distribution of milk to the consumer must be cleaned and sterilized (boiled, baked, scalded, or steamed) by the milk dealer before they are again used for the same purpose.

SEC. 16. No metallic or card ticket shall be used in connection with the sale or distribution of milk in the city of Erie, but instead thereof a coupon ticket shall be employed, and such ticket shall be canceled and destroyed after being once used.

SEC. 17. Under no circumstances shall a milk dealer in the city of Erie, or his or her employee, take from a quarantined house any money, can, bottle, etc., or enter such a house for any purpose whatever without written permission from the board of health.

Montclair, N. J.

AN ORDINANCE CONCERNING THE PRODUCTION OF MILK AND REGULATING ITS SALE.

Be it ordained by the board of health of the town of Montclair, in the county of Essex, as follows:

SECTION 1. Every person, corporation, or association of persons who now is or who hereafter shall be engaged in the sale or exposure for sale of milk within the town

of Montclair, before selling or exposing the same for sale, shall furnish the board of health of the town of Montclair a true and complete statement as to the locality from which the milk so sold or exposed for sale is produced; also a full and complete list of the names and addresses of persons from whom the said milk is purchased, and the names and addresses of all persons to whom they are regularly selling or delivering milk within said town; said lists shall be furnished to the said board on the first days of January, April, July, and October of each calendar year, and at all other times when requested by the said board.

SEC. 2. No milk shall be sold or exposed for sale in the town of Montclair except milk from cows stabled under light, dry, and well-ventilated conditions, and in all other respects conforming to the requirements hereinafter set forth, viz:

(*a*) Each cow shall have at least 3 feet in width of floor space when fastened in stanchions, and in all cases where no adequate artificial means for ventilation are provided, each animal shall have an air space of at least 500 cubic feet.

(*b*) All stables for the shelter of said cattle shall be provided with a tight dry floor. The manure drop shall be water-tight, and if constructed of wood shall be asphalted, tarred, or otherwise made nonabsorbent.

(*c*) The walls and ceilings of said stables shall be whitewashed whenever it may be deemed necessary by this board of health.

(*d*) Manure shall not be allowed to accumulate in large quantities in stable yards nor near the buildings where the cattle are kept, and when stored temporarily in such places it shall be removed at least once per month. The said stable yards shall be drained and kept in a clean dry condition, and no accumulation of household garbage, vegetable, or other putrescible matter shall be allowed to remain or decay in said stable yards.

(*e*) Cattle shall at all times be kept in a clean condition, and udders shall be washed, hand rubbed, or wiped with a clean damp cloth before each milking.

(*f*) No milk shall be sold or offered for sale or distribution in the town of Montclair unless the cows from which it is obtained have within one year been examined by a competent veterinarian, and are free from diseases dangerous to the public health. But this shall not be construed as forbidding the sale or use of milk from cows not tested with tuberculin.

(*g*) No milk shall be sold or offered for sale or distributed in the town of Montclair obtained from any cow that has calved within ten days or from a cow which will come in or calve within sixty days.

SEC. 3. No milk shall be sold or exposed for sale in the town of Montclair except milk produced from cattle fed and watered under the following conditions: All food given to such cattle shall be fresh, sweet, and wholesome. The use of either distillery slops or fermented brewers' grains is prohibited, and their presence on any dairy premises will be considered sufficient cause for the exclusion of the milk from such dairy from sale or delivery in said town. Water supplied to cattle shall be pure and free from all contamination by stable or household drainage, and no well or spring in or adjoining any stable yard shall be used for watering said cattle.

SEC. 4. All milkers and other attendants employed in any dairy, the milk from which is to be sold or offered for sale or delivered in said town, shall be personally clean. Before entering upon their duties connected with the dairy, hands shall be washed, and clothes changed or brushed, and no milk shall be delivered or sold or exposed for sale in said town produced from dairies wherein the foregoing regulations are not enforced.

SEC. 5. Utensils used for the collection and transportation of milk shall, before being used, be thoroughly washed with pure water and soda or soap, and then sterilized by boiling or steaming.

SEC. 6. Milk which is to be delivered or sold or offered for sale in said town shall, immediately upon being drawn from the cow, be removed from the stable to a room

separate and apart from the said stable, and immediately cooled by submerging the vessel in which the milk is contained in cool water to a depth equal to that of the said milk in the vessel. The above-mentioned room shall be properly ventilated and lighted and shall be used for no other purpose than that indicated above, and shall at all times be kept in a clean condition.

SEC. 7. The said milk shall be delivered in bottles unless permission for delivery in another manner shall be granted by said board. No tickets shall be used in connection with delivery of milk.

SEC. 8. If at any time any person or persons having any connection with a dairy from which milk is delivered or sold or offered for sale in the town of Montclair, or any resident member of the family of any person so situated, shall be stricken with cholera, smallpox (including varioloid), diphtheria, membranous croup, yellow, typhus, typhoid, or scarlet fever, measles, or any other communicable disease that may hereafter be declared by this board to be dangerous to the public health, notice shall be given to said board immediately by the owner or owners of such dairy, and no milk produced from the dairy of any corporation, person, or association of persons failing to give the notice herein required shall hereafter be sold or exposed for sale or delivered in the town of Montclair until special permission therefor has been granted by said board.

SEC. 9. Any person, corporation, or association of persons violating any of the provisions of this ordinance shall, on conviction thereof, be liable to a penalty of not less than $10 nor more than $100.

SEC. 10. All ordinances or parts of ordinances inconsistent with the provisions of this ordinance are hereby repealed.

Passed March 24, 1898.

Chicago, Ill.

ORDINANCE SECTIONS REGARDING QUALIFICATIONS, REQUIREMENTS, AND DUTIES OF MILK INSPECTION OFFICIALS.

SEC. 934. There shall be appointed by the commissioner of health a superintendent and an assistant superintendent of the milk and food division. They shall be persons skilled in the science of analytical chemistry and bacteriology, and, before entering upon their duties, shall each execute a bond to the city of Chicago in the sum of $5,000, with good and sufficient sureties to be approved by the mayor, conditioned for the faithful performance of the duties of their respective offices.

SEC. 936. There shall also be employed in the milk and food division of the department of health hereby created such assistants, employees, and inspectors as shall be deemed necessary by the commissioner of health, and they shall be under the direction of the superintendent and shall perform such duties as are in this article provided and as the said superintendent may additionally direct. The inspectors employed under this article shall give a good and sufficient bond to the city of Chicago in the sum of $2,000, to be approved by the mayor, and conditioned for the faithful performance of their duties.

ORDINANCE SECTION REFERRING TO SIGNS ON DELIVERY VEHICLES.

SEC. 943. No milk or cream shall be sold, offered for sale, exposed for sale, exchanged, delivered, transported, conveyed, or carried on any wagon, carriage, or other vehicle unless the owner or owners thereof shall first obtain from the city clerk two painted metal plates 8 inches long and 4 inches wide, on which shall be stamped the number corresponding to the license, and also the words "Chicago Milk Peddler," together with the year for which the license is issued, which plates the said licensed owner or owners shall cause to be securely fastened on the outside of each side of the box of his vehicle so licensed, or in a conspicuous place so that the same can be easily seen.

Grand Rapids, Mich.

ORDINANCE SECTION REGARDING MILK LICENSE FEES.

SEC. 2. Any person or persons desiring to sell, barter, or traffic in milk within the city of Grand Rapids, on his or their application to the city clerk of said city shall be licensed to do the same as hereinafter provided, and shall be granted a permit therefor upon the payment of the following license fee: For the selling of milk from wagons, $5 per year; from milk carts propelled by hand, $1 per year; from cans carried by hand, 50 cents per year; for selling from dairies or creameries, $5 per year; and for selling from private houses or restaurants and all other places, $1 per year: *Provided, however,* That where more than one milk wagon is owned, operated, and controlled by the same person or firm, that a license fee of $2 shall be charged for each additional wagon, which said sum shall be paid to the city clerk and by him paid to the city treasurer. Said license shall continue and be operative until the first Monday in May next ensuing the issuance of the same, unless sooner revoked as hereinafter provided, and the license fees above provided shall be the same for a full year or for any part thereof: *Provided, however,* That no fee shall be charged any farmer for such license or permit who does not sell any milk whatever except such as he produces from his own cows on his own farm.

Houston, Tex.

ORDINANCE SECTIONS DEFINING THE TERMS ADULTERATED, ETC., AND REFERRING TO MILK BROUGHT INTO THE CITY.

SEC. 15. The terms adulterated, impure, unhealthy, and unwholesome, applied to milk or dairy products, and as used in this ordinance, mean—

(1) Milk containing less than 12 per centum of milk solids.

(2) Milk containing more than 88 per centum of water or fluids.

(3) Milk containing less than 3.2 per centum of fats.

(4) Milk drawn from cows within fifteen days before or within five days after parturition.

(5) Milk drawn from cows fed on any unhealthy or unwholesome food.

(6) Milk drawn from cows kept in an unhealthy or unsanitary condition, or from cows affected with any form of disease, or from cows which are supplied with water which is impure or unwholesome.

(7) Milk from which any part of the cream has been removed.

(8) Milk which has been diluted with water or with any other fluid, or to which has been added or into which has been introduced any foreign substance whatever.

(9) Milk drawn from cows, or by milkers that are themselves, in a condition of filth or uncleanliness.

(10) Any milk which is shown by analysis to contain any substance or substances of any character whatsoever not natural or normal constituents of milk, or to have been deprived either wholly or in part of any constituent naturally or normally contained in milk.

SEC. 24. It shall be the duty of the owner or consignee of milk brought into the city of Houston by land over any road or railroad leading into the city of Houston to cause the same to be tendered and exposed for inspection according to the requirements of said health officer: *Provided,* That said milk shall not be detained for inspection for a longer period than one hour.

Fall River, Mass.

REGULATION 71, REFERRING TO SKIMMED MILK.

SEC. 4. Skimmed milk shall not be sold, exchanged, or delivered within the city of Fall River unless a special license therefor shall have been first obtained from the board of health, which will be granted only on conditions that the provisions of the public statutes shall be observed and that the words "Skimmed Milk," the name of the licensee, and the number of the special license shall be painted on both sides of the wagon or other vehicle or can or vessel used to convey or hold the milk, in letters and figures 2 inches in length and one-half inch in width and in some contrasting color to that of the wagon or can.

Fort Wayne, Ind.

ORDINANCE SECTION REGARDING DELIVERY OF SKIMMED MILK.

SEC. 6. No skimmed milk shall be sold, offered for sale, exchanged, delivered, transported, or carried in any wagon, carriage, or other vehicle unless the same is carried and contained in a can or vessel painted red, on which are conspicuously painted or printed the words "Skimmed Milk" in large, plain roman letters not less than 2 inches long.

Milwaukee, Wis.

ORDINANCE SECTION REQUIRING COVERING ON MILK DELIVERY VEHICLES.

SEC. 4. No person or persons shall bring to or deliver milk in the city of Milwaukee for the purpose of retailing the same to consumers in the city of Milwaukee in any open or uncovered wagon, cart, or conveyance of any kind; and all milk hereafter to be brought to the city of Milwaukee to be retailed to consumers, or for that purpose to be delivered in the city of Milwaukee, shall be brought to said city and delivered in cars, wagons, or carts so constructed that the covering hereinbefore provided for shall not come in contact with the cans or vessels containing the milk, and shall protect such milk and the cans or vessels containing the same from the sun and rain, and, as far as practicable, from the dust and all the impurities of the air.

Kansas City, Mo.

ORDINANCE SECTION REGARDING DAIRY INSPECTIONS.

SEC. 1033. *Examination of stables, lots, etc.* It shall be the duty of the sanitary sergeant and the policemen and city chemist to at least once every two months, and as much oftener as they think necessary and proper, inspect and examine all stables, lots, and pastures where cows are kept and fed whose milk or cream therefrom is sold in the city; as also the food such cows are fed, and the health and condition of such cows, and make report thereof to the sanitary superintendent. If in their opinion any such cows are not fed on good and wholesome food or are kept in an unhealthy and bad condition, or such stables and pastures are not properly cleaned and kept so, then they shall so notify, verbally or in writing, the owner or keeper of such cows, stables, and pastures and also the persons who sell or offer for sale the milk or cream therefrom in the city. And if any such owner, keeper, or person shall not at once cease to milk any cow in an unhealthy and bad condition, or shall refuse or neglect to at once proceed to clean such stables and pastures, the milk therefrom shall not be sold or offered for sale in the city until every objection thereto is abated and removed and kept so. Every person violating any provision in this section contained shall be deemed guilty of a misdemeanor and on conviction shall be punished by a fine of not less than $50 nor more than $500.

Rochester, N. Y.

ORDINANCE SECTION REGULATING THE NUMBER OF COWS TO BE KEPT IN THE CITY.

SECTION 1. No person, firm, or corporation shall keep or allow to be kept in any building or on any grounds or premises of which such person, firm, or corporation shall be the owner, lessee, or occupant, when such buildings, grounds, or premises are situated within the built-up portion of the city of Rochester, more cows than 1 to a city lot of 33 feet by 150 feet, or space equal thereto, and no person, firm, or corporation shall keep or allow to be kept in any building or on any premises, of which such person, firm, or corporation shall be the owner, lessee, or occupant, where such buildings or premises are situated in the outlying portions of the city, and where such premises are not subdivided into city lots or actually occupied as such, more than 15 cows to each acre of land owned or occupied by such person, firm, or corporation, without a permit from this department. Every permit issued under this ordinance shall be subject to the rules, regulations, or ordinances of this department and may be revoked at pleasure of the department.

San Francisco, Cal.

ORDINANCE SECTION CONCERNING CARRYING SWILL ON MILK DELIVERY VEHICLES.

SEC. 9. It shall be unlawful for any person or persons, firm, or corporation to have or carry on any wagon or vehicle upon or from which milk or cream is being or is brought, carried, stored, deposited, sold, exchanged, delivered, or distributed or offered or exposed for sale or distribution as food for any human being, any swill, garbage, refuse, or any decaying or fermenting, putrefying, foul, unwholesome, noxious, or filthy matter, or any cans or receptacles containing any material or substance with which cream or milk might be diluted, adulterated, or rendered impure, unwholesome, or unhealthy.

Denver, Colo.

ORDINANCE SECTION REGARDING NOTICE OF USE OF WATERED MILK.

SEC. 489. All pure milk shall be deemed to contain 12 per cent of milk solids, and any hotel, boarding house, or restaurant furnishing milk to their boarders, guests, or customers, or any of them, containing a less quantity of milk solids than 12 per cent, or a greater quantity of water than 88 per cent, shall cause to be posted and kept in a conspicuous place in the dining room where such milk is furnished for use a card with the words "Watered Milk" plainly printed thereon in large letters not less than 3 inches in length, so that the same may be plainly read from all parts of the room.

Malden, Mass.

ORDINANCE SECTION REQUIRING THE PUBLICATION OF NAMES OF VIOLATORS.

SEC. 5. The inspector shall cause the name and place of business of every person convicted of selling adultered milk or vinegar, or of having the same in his possession with intent to sell, to be published in two newspapers in the city or county.

APPENDIX II.

The following is a copy of instructions sent out by an enterprising Boston milk contractor to the dairymen from whom his milk is obtained. Such an effort on the part of milk dealers to induce the observance of proper methods in the production and handling of milk is most commendable. Numerous dealers throughout the country have adopted the same plan, using short original circulars similar to this one. In some cases, upon special request, the United States Department of Agriculture has mailed appropriate Farmers' Bulletins to list of names of milk producers furnished for this purpose by those who are receiving and selling milk in cities.

Suggestions and Rules for Dairymen Supplying Milk for Boston, Mass.

Recent investigations of our milk supply have shown us the need of greater care on the part of the dairymen in the production of a cleaner and more sanitary milk. The following suggestions are those most necessary, and we earnestly hope will be carried out by you:

A. WHITEWASHING COW STABLES OR "TIE-UPS."

Whitewash acts as a mild antiseptic and adds greatly to the general cleanliness and healthfulness of the stable. It should be applied both fall and spring, and it is thought by the associated boards of health of Massachusetts that it should be required of all dairymen. It is gratifying to note that when whitewashing has been done in this way the farmers are very much pleased with the result.

B. ENSILAGE.

While ensilage is a very good food when fed in moderate quantities, there is a great tendency to feed too much of it and in that way injure the quality and flavor of the milk. It may be fed to the extent of one-half bushel per cow once a day directly after milking without injury to the milk.

Silos in the barn are unsanitary and fill the air with a very disagreeable odor. This is breathed by the cows, and is also absorbed by the milk, in that way injuring it permanently.

C. MILKING AND CARE OF MILK.

We call special attention to the fact that the cow's udder should be thoroughly cleansed by rubbing with a damp cloth previous to milking, as any loose dirt falling into the pail causes the milk to spoil quickly, even though it is strained out immediately afterwards, as half of it dissolves in the milk, and therefore can not be removed by straining. The milker's hands should also be *washed* and *dried* just previous to milking, and should never be wet with the milk, as is the custom at present in some dairies. Milk will keep better if the first teaspoonful or two from each teat be milked on the floor or otherwise rejected, as this milk always contains the germs that cause quick souring. If we could imagine a portion of the milk removed directly from the cow's udder into an absolutely clean can, and covered with absolutely clean cotton batting one-fourth inch thick or more, this milk not having come in contact with the dust of the air or dairy utensils, it would keep in this way in perfect condition for weeks. Milk should be removed from the cow stable as soon as drawn, and should then be strained preferably through clean flannel and cooled as soon as possible to 40° F. and held at that temperature, covered with a clean cloth until collected.

We again call attention to the fact that milk must be artificially cooled in winter

as well as summer by placing the cans in cold water. Metal strainers soldered into the pail are objectionable, as it is almost impossible to keep them clean. Flannel for straining should be wrung out of hot water just before using.

D. PAILS, CANS, AND STOPPLES.

We have found that, while a dairy in general may be clean and care taken with the milk, the latter sometimes fails to keep well. We have traced this trouble to pails, cans, and stopples. Milk pails should have all seams filled up flush with solder and should be thoroughly scalded, washed in strong suds both morning and night, and kept inverted until used for milking. Cans must be cleaned with *boiling sal soda* solution and rinsed with clean *boiling* water. Rinsing water from one can must not be used in rinsing another. If means are at hand they had also better be thoroughly steamed for ten minutes. This may be done by putting a quart of clean water in the can and placing on the stove to boil. Do not attempt to wipe out the cans or pails, but let them dry in an inverted position. Wooden stopples should be boiled in sal soda or soap powder solution for fifteen minutes and then rinsed thoroughly.

E. INFECTIOUS DISEASES.

Any disease of an infectious or contagious nature (typhoid fever, scarlet fever, diphtheria, etc.), whether of the person handling the milk or in his family, must be reported to us at once, as several cases have occurred in Somerville, Cambridge, and East Boston, where neglect to do this has resulted disastrously to the dealers.

Keep this for future reference.

APPENDIX III.

The following is a copy of an agreement made between the Medical Milk Commission of Essex County, N. J., and the party supplying milk according to its requirements and receiving its indorsement (names of persons being here omitted):

COPY OF THE AGREEMENT BETWEEN THE MEDICAL MILK COMMISSION OF ESSEX COUNTY, N. J., AND ——— ———, CALDWELL, N. J.

[Dated May 19, 1893.]

The following agreement, made this 19th day of May, 1893, between ....., parties of the first part, and ....., New Jersey, party of the second part, wit' esseth as follows: That the party of the second part doth hereby bind himself to a fulfillment of the provisions of this contract for and in consideration of the benefits hereinafter named by the parties of the first part.

Furthermore the following-named persons, ..., New Jersey, all acquaintances of the party of the second part, hereby affix their signatures to this agreement, attest to the honor of the party of the second part, and become sureties for the execution of this agreement.

(1) The party of the second part doth hereby agree to conduct such parts of his dairy as may be hereinafter named, collect, and handle its products in conformity with the following code of requirements, for and in consideration of the promised indorsement of the parties of the first part, as hereinafter indicated. The milk thus produced shall be known as certified milk, shall be designed especially for clinical purposes, and when at any time the demand shall be greater than the supply, and

is required by a physician, either for infant feeding or the diet of the sick, it is hereby agreed that such shall be the preferred purchaser.

(2) The party of the second part further agrees to pay for chemical and bacteriological examinations of the aforesaid certified milk at such times as in the judgment of the parties of the first part is desirable.

(3) He also agrees to defray the cost of a bimonthly inspection of his dairy stock or oftener, if necessary, by a competent and approved veterinarian, all of which persons—namely, the chemist, the bacteriologist, the veterinary surgeon—shall be chosen by the parties of the first part, to whom they shall render their reports in writing.

(4) It is expressly understood and agreed that the party of the second part shall not pay more than the sum of $500 in any one year for the services of chemist, bacteriologist, and veterinary surgeon, and the party of the first part shall limit the expense of such service to that amount. It is furthermore agreed that the party of the second part, on receipt of a certified copy of the reports of the experts, shall mail to the persons indicated by the parties of the first part, and not to others, a duplicate printed copy of the foresaid reports, bearing the signatures of the experts and the names of the physicians. The same to be issued at such intervals as in the judgment of the parties of the first part is desirable; also that the necessary expenditures for printing and circulation be met in the same way as herein provided for expert examinations.

LOCATION OF LANDS.

(5) It is hereby understood and agreed that the lands used by the owners, agents, or assigns of the dairy conducted by the party of the second part, and employed for pasturage, or any lands that may hereafter be acquired for such purposes, or such lands as may be used for the cultivation of hay or fodder, shall be subject to the approval of the parties of the first part.

BUILDINGS.

(6) It is also understood and agreed that the buildings, such as stables, creamery, dairy house, and spring house, shall be constructed after the most approved style of architecture, in so far as construction may affect the health of the dairy stock or the character and conditions of the milk.

(7) That the buildings used for the housing of the animals shall be situated on elevated ground and capable of being properly drained.

(8) Said buildings to be sheltered from cold winds, lighted, and ventilated according to approved hygienic methods. The buildings shall be constructed so as to favor the prompt and easy removal of waste products.

(9) The apartments used for the storage of either feed or fodder shall be removed from possible contamination by stable waste or animal odors.

(10) All buildings shall, in addition to healthy location, approved construction, and proper ventilation, be kept free from animal or vegetable matter in a state or process of decomposition or decay, and always free from accumulations of dust or mold.

THE WATER SUPPLY.

(11) The dairy shall be supplied with an abundance of pure water.

(12) No water from shallow wells or springs holding surface drainage shall be used for watering stock, cooling milk, or cleaning vessels.

(13) Nor shall any well or spring be located within 300 feet of the stable.

SURROUNDINGS.

(14) It is further understood and agreed that the immediate surroundings of the buildings shall be kept in a condition of cleanliness and order. There shall not be

allowed to accumulate in the vicinity any loose dirt, rubbish, or decayed vegetable or animal matter or animal waste.

(15) Nor shall there be within 300 yards of any building any constantly wet or marshy ground or stagnant pools of water.

(16) Nor shall there be kept within 300 yards of any building used for dairy purposes any fowl, hogs, horses, or other live stock.

(17) It is hereby understood and agreed that the following unhealthy conditions shall be a sufficient reason to exclude any animal from the herd used for any purpose in the aforesaid dairy: Any animal that is judged by a competent observer to suffer from tuberculosis, even though the disease be localized in a part distant from the vital organs.

(18) Any animal with fever. Any animal suffering from septic absorption or other disease following or associated with parturition.

(19) Any animal suffering either from mammitis or mammary abscess.

(20) Any animal with persistent diarrhea or any other abnormal physical condition which could in any way be detrimental to the character of the milk.

(21) It is furthermore agreed that when an animal shall be found by a competent observer to be in a state of ill health, prejudicial either to the other animals in the herd or to human health, the same shall be removed immediately, and if necessary shall be killed.

(22) It is also understood and agreed that the party of the second part shall exclude from the herd used for producing certified milk, immediately after discovery, any animal subject to the following conditions: Any animal that was bred through consanguinity within a period of three generations.

(23) And from this time forth any animal of those bred by the party of the second part, used for producing certified milk, that was not, as a heifer, kept sterile during its first twenty-seven months.

(24) Any phenomenal milker, except that glandular disease or tuberculosis has first been excluded by a competent observer.

(25) It is furthermore agreed that if at any time it is desired by the parties of the first part that a different breed of milch cows should be substituted for the one in use, in order that the standards of quality in the milk may be raised, the party of the second part will endeavor to carry the same into effect.

HOUSING AND CARE.

(26) It is furthermore agreed that the dairy stock employed in the production of certified milk shall be properly sheltered from the influence of weather and climate prejudicial to their health; also that the animals shall be kept clean, groomed every day, and treated kindly at all times.

(27) The waste products of the stable shall be removed so frequently, and the stable floor so thoroughly cleaned, that the same shall be as free as possible from animal odors.

(28) It is also agreed that no milch cow shall be used for dairy purposes while in a state of excitement, either as a result, or during the period of, estrux, or which has been made nervous either by beating, whipping, kicking, prodding, or running.

FEEDING.

(29) It is hereby understood and agreed that the methods of feeding the cows furnishing the certified milk shall be subject to the approval of the parties of the first part. The feed and fodder shall consist only of nutritious and wholesome materials, such as grass, clover and timothy hay, whole grain, or the entire result of the grist. No materials shall be employed which are or may become injurious to the health of the animals. There shall not be fed at any time or in any quantity, either alone or mixed with other feed or fodder, hulls, screenings, wet or dry brewers' grains, oil

cake, sour ensilage, the refuse from distilleries, glucose of starch factories, any waste by-product in the treatment of grain, low marsh grass, or any of the questionable or exhausted feeds or fodders employed either to increase the milking capacity of the animal, or that will produce an impoverished milk, or that will impart to it unnatural odors or flavors. Nor shall the cows be allowed to eat green or worm-eaten fruit, poisonous weeds, or to drink poisonous or stagnant water.

COLLECTING AND HANDLING.

(30) It is furthermore understood and agreed that the cows from which is obtained certified milk shall be milked only in a clean building, and not in an illy ventilated stable containing foul odors and bad air.

(31) No animal furnishing certified milk shall be milked until the udder shall first have been cleaned in a manner approved by the parties of the first part.

(32) No person shall be allowed to draw the milk that has not, within fifteen minutes of the milking, first washed his or her hands, using soap and nail brush, and afterwards thoroughly rinsing the hands in clean water.

(33) The person or persons engaged in milking shall also be dressed in clean overclothes.

(34) No person shall be allowed to draw the milk who has been engaged with the care of horses in the same clothing or without first washing his hands.

(35) No milk shall be represented as certified milk that is not received from the udder into vessels, and from these into cooling cans, both of which are perfectly clean and dry, having been cleansed and heated at a temperature adequate to effect complete sterilization since the last milking and have been kept inverted in a clean, dry, and odorless atmosphere.

(36) No milk shall be represented as certified milk that has not been passed through a sieve of wire or other cloth, either while milking or immediately thereafter, having not less than 100 meshes to the linear inch.

(37) No milk shall be represented as certified milk that does not consist of the entire contents of the udder at each milking, including the foremilk, middlings, and strippings.

(38) No milk shall be represented as certified milk that has been drawn from the animal at abnormal hours, such as midnight or noon, nor from any animal for a period of nine weeks before calving, or that has not been separated for nine days after parturition.

(39) No milk shall be represented as certified milk which has been exposed to the emanation or infection of any form of communicable disease, either in the person or persons handling the milk or by accidental contamination in cleaning milk containers, or by the association of any person engaged in handling the milk, with person or persons sick of contagious disease.

PREPARATION FOR SHIPMENT.

(40) It is hereby understood and agreed that all milk represented as certified milk shall receive every known detail of care that will promote its keeping qualities and favor its safe transportation.

(41) That the milk on being drawn from the cow shall be treated by ice or clean, cold water in motion, and proper aeration, in order, first, to remove its animal heat, and, second, to reduce its temperature to a point not above 50° nor below 40° F.; said temperature to be acquired within forty-five minutes after milking and maintained within the above limits while held for shipment, during its transportation, and until it is delivered to the purchaser.

(42) That the cooling of the milk shall not be conducted in the same building in which it is drawn, nor in an atmosphere containing dust or tainted with animal odors.

(43) That all the foregoing provisions concerning the cleansing and condition of vessels or utensils shall be complied with in the said cooling process.

(44) It is furthermore agreed that no milk shall be represented as certified milk that has been changed or reduced in any way by the addition of water or any solid or liquid substance in or out of solution, or the subtraction or removal, in any manner, of any part thereof.

(45) It is hereby understood and agreed that all milk to be represented as certified milk shall be packed in flint glass quart jars immediately after it is cooled.

(46) Said jars to be of a pattern approved by the parties of the first part.

(47) It is furthermore agreed that the bottles or jars, before being used, shall be cleaned by hand, separately, with the aid of hot water, alkaline soaps, rotating brush and steam, and that they shall be rinsed in two separate baths of clean, hot water and then thoroughly dried and kept inverted until used, without covers, in a clean dry atmosphere free from odors.

(48) It is agreed that the jars shall be filled by a method approved by the parties of the first part.

(49) That they shall be sealed, after all air has been excluded, by the most approved device for closing them.

(50) The bottles after being filled shall be labeled across the cap, bearing the words "Certified milk," with the name of the dairyman, together with the date of milking.

(51) It is furthermore agreed that no milk shall be sold as certified milk that is more than three hours old when bottled nor more than twenty-four hours old when delivered.

TRANSPORTATION AND DELIVERY.

(52) It is hereby understood and agreed that the transportation and distribution of all milk represented as certified milk shall be conducted by the party of the second part, either in person or by persons employed by him.

(53) That in transit the milk shall not be exposed to any of the foregoing prohibitory conditions.

(54) That it shall not be subjected to agitation.

(55) That it shall not be exposed to the heat of the sun.

(56) That the delivery wagons shall be so constructed that the required temperature of the milk may be maintained during transit.

(57) That before the wagons are filled for shipment the body, the trays, and compartments shall be flushed with boiling water.

(58) It is furthermore agreed that the distributing agents shall, during the transfer of the milk from the dairy to the purchaser, be subject to the following restrictions, namely, that they shall use no tobacco.

(59) That they shall take no intoxicating drinks.

(60) That they shall not collect the empty containers, nor receive money or milk checks from houses in which an infectious or contagious disease is known to exist.

(61) It is also hereby agreed that the collection of empty bottles from places where infectious or contagious disease is known to exist shall be made by other persons than those employed to deliver the milk.

(62) That these collections be made with wagons not employed in the distribution of the milk.

(63) That before these empty bottles shall be returned to the dairy they shall be carried to a separate building and first be subjected to the process of cleaning bottles indicated in a former clause of this contract.

(64) It is hereby understood and agreed that if any further precautions or changes in method calculated to improve the quality of milk or guard the same from impurities or dangers is desired, that the party of the second part will cheerfully be gov-

erned by such additional rules and regulations as may be laid down by the parties of the first part.

(65) It is understood and agreed by the party of the second part, the same binding the owners, agents, or assigns of the aforesaid dairy, that the product known as certified milk shall be under the following restrictions in its sale, namely: That until the amount required within the boundaries of Essex County shall first be supplied, it shall not be sold beyond these limits, except that the parties of the first part shall give their consent.

(66) It is furthermore agreed by the party of the second part, the same binding the owners, agents, or assigns of the aforesaid dairy, that in the event of a failure to comply with any or all of the requirements of the foregoing contract, the party of the first part shall reserve the right to withdraw from the contract and publish the fact in such manner as they deem best.

(67) Finally, it is understood and agreed that nothing in this contract shall prevent the abrogation of any of the provisions of the same by the parties of the first part, provided that it shall be done for the purpose of substituting other provisions designed to promote the objects of their organization.

(68) It is further understood and agreed by and between the parties hereto that the party of the second part shall be at liberty to cancel this agreement by giving two months' notice in writing of his desire to do so, in case of inability for any reason to comply with the terms of the same.

In witness whereof, the said parties have hereunto set their hands the day and year first above written.

_____ _____,
_____ _____,
_____ _____,
_____ _____,
_____ _____,
_____ _____,

Parties of First Part.

_____ _____,

Party of Second Part.

_____ _____,
_____ _____,
_____ _____,

Sureties.

At frequent intervals reports upon the conditions of the dairy and quality of the milk are rendered to the commission by experts appointed for this purpose.

APPENDIX IV.

Following are copies of blank forms used in the supervision of market milk. For brief discussion of them see page 22. A suitable space for the answer to each question is always provided, but in the longer forms the spaces are here shortened.

Form for application for milk license, Cambridge, Mass.

CITY OF CAMBRIDGE. OFFICE OF INSPECTOR OF MILK, CITY HALL.

APPLICATION FOR MILK LICENSE.

Date of application, ... Present license No. .....
Name (if a firm, give firm name and also individual members' names in full):
.....
Address:
.....

No. of teams:	Driver.	Residence.
1.	.....	.....
2.	.....	.....
3.	.....	.....
4.	.....	.....
5.	.....	.....

No. of cans of milk sold per day in Cambridge { Wholesale, ... Retail, ...

Cream, quarts, ... Skimmed milk, cans, ...

Source of milk (if from a contractor, give name of contractor; if from farms, give the town or towns where they are located; if from your own farm, give location of dairy and number of cows kept.)

.....

Signature of applicant: ....

Form for application for milk license, Chicago, Ill.

DEPARTMENT OF HEALTH, CITY OF CHICAGO. DIVISION OF MILK INSPECTION.

APPLICATION FOR MILK LICENSE.

STORE LICENSE.

....., 189..

Name, ... Location of business place or places, ... Number of wagons, ... Number of cows, ... Description of wagon or wagons (number, inscription, and color), ...

Your attention is called to the section of the milk ordinance relating to applications for milk licenses:

"SEC. 17. (License, issue of, application for.) Licenses shall be issued in the names of the applicants therefor. Before the issuance of the license every vendor of milk or cream shall make written application therefor on a printed form provided for that purpose, on which shall be stated:

"First. The name, residence, and location of the business place or places of the applicant.

"Second. The number of cows, if any, owned or controlled by the applicant.

"Third. The number and description of each and every wagon, carriage, or other vehicle used in the milk or cream business.

"Fourth. If, after the issuance and delivery of the license, any change be made in the location of the place of business of such licensee, notice thereof must forthwith be given to the chief of milk inspection."

Signed: ....

TO THE CITY COLLECTOR:

The above application is approved and issue of license is hereby recommended.

....., *Commissioner of Health.*

License No. .....

NOTE.—The form used in applying for wagon license is the same in all respects, except it is a different color.

Form for application for milk license, Erie, Pa.

APPLICATION FOR MILK LICENSE.

BOARD OF HEALTH,
Erie, Pa., ..., ...

I hereby make application for permission to sell milk in the city of Erie, from a ....., subject to your rules and regulations.

The dairies from which I obtain milk are located in ..... township, and are owned by ..... There are no injured or diseased cattle in the herd or herds from which said milk is obtained; and there are no cases of typhoid fever, consumption, diphtheria, scarlatina, or other contagious or infectious diseases in my house, family, or among my employees or in the house, family, or among the employees of the owner of said dairy or dairies. In case of the appearance of any of the above-mentioned diseases I will immediately make report thereof to the board of health.

Name: ....
Residence: ....

Sworn and subscribed before me this ..... day of ....., ...
....., *Secretary Board of Health.*

Form for application for inspection, Meadville, Pa.

APPLICATION FOR INSPECTION.

To .....,
Inspector of Food and Milk for the City of Meadville, Pa.:

Desiring to sell milk to the citizens of Meadville, Pa., I make application to you to inspect my cattle and appointments for the supply of milk, under the rules and regulations of the board of health of said city, and I hereby agree to observe strictly the following regulations regarding the milk which I supply to all my customers:

No milk shall be delivered—

(1) From cows that are unhealthy; from cows receiving any kind of medicine; from cows with inflamed udder or with udder or any part thereof in an abnormal condition from any cause; from cows while in heat, unless such cows are kept from the rest of the herd during that time; from cows within 60 days before or six days after calving.

(2) From cows that are fed partially or wholly on turnips, cabbage, ensilage, brewery, or distillery malt, rancid foods, or any other kind of food that would deteriorate or taint the quality of the milk; from cows supplied with bad or impure drinking water.

(3) Nor shall any milk be delivered which has been drawn from the cow more than fifteen hours, nor from which any part of the cream has been removed, or from which strippings have been kept back; nor will I sell during the summer any milk which was milked prior to 5 o'clock in the afternoon, nor milk which differs in any way from fresh, sound, pure, unadulterated cow's milk.

(4) I also agree that I will not furnish milk from any cows unless they have been inspected by milk inspector for Meadville board of health, and that my cows are to be milked in the cleanest possible manner, without moistening the teats; that milkers' hands shall be kept clean, and udders wiped with a clean damp cloth just before milking. I also agree that all my milkers shall wear a clean outer garment, to be used for no other purpose than for milking, and to be worn at each milking.

I agree to remove each cow's milk immediately after milking from the stable and to strain, cool, and aerate all of my milk until the temperature is reduced to 58° F. in less than 45 minutes by placing the cans in a tub or vat, said tub or vat to hold

three times as much water as the quantity of milk to be cooled, water in said tub or vat to be renewed daily.

I agree that special care shall be taken to remove daily all manure from the stables and anything of a foul or unclean nature, and to keep my stables clean, and whitewash the same each fall and spring every year.

I agree to keep my cow yards reasonably free from mud or manure, and that I will not stack manure against my cow stables at any time.

I agree should any member of my family or employee become sick with any contagious disease that I will immediately notify the health officer and milk inspector of the Meadville board of health.

I agree to notify the milk inspector of any dwelling placarded for contagious disease, if said building is occupied by persons to whom I sell milk.

I also agree that the Meadville board of health, or any member thereof, or any person in the employ of said board, shall have the right to visit at any time my premises for the purpose of inspecting the cows, stables, milk house, food and water supply, and take samples of milk at any time from my dairy or on my route, in order to see that the foregoing rules are observed.

Having read the above, I hereby agree to all the provisions contained therein and hereby agree that the Meadville board of health may revoke my permit for noncompliance of said provisions at any time.

Signed: ....,
..... 19...

Form for application for milk license, Iowa.

CITY MILK DEALER'S REPORT FOR YEAR ENDING JULY 4, 1901.

The law requires that the permit be taken out before selling milk or cream. Any one selling milk without having the permit is subject to the penalties named in the law. See below. This department will not hold itself under obligations to send further notice, and action will begun at the discretion of the dairy commissioner after the 4th day of July, 1901, without further notice.

READ THE LAW.

SEC. 2525. *Permits.*—Any person or corporation who shall sell milk or cream from a wagon, depot, or store, or sell or deliver milk or cream to a hotel or restaurant or boarding house, or any public place in any such city, shall be considered a city milk dealer. No such city milk dealer shall sell milk or cream from a wagon, depot, or store in any such city without a written permit from the commissioner for each wagon, depot, or store operated by him, for which he shall pay annually one dollar. All permits shall expire on the fourth day of July of each year, and no permits shall be issued for less than one dollar.

SEC. 2527. *Penalties.*—Whoever shall violate any provisions of this chapter shall be punished by a fine not exceeding five hundred dollars, or by imprisonment in the county jail not exceeding six months, or by both such fine and imprisonment, at the discretion of the court.

Name of dealer, firm, or company. (Please write all names and addresses plainly.) .....

City, ... Street and number or P. O. box, ...

Do you sell whole milk? ..... Cream? ..... Skimmed milk? .....

How many months in the year do you conduct your business? .....

How many families, hotels, etc., do you supply? Private families, ... Hotels, ... Restaurants and lunch counters, ... Boarding houses, ... Ice-cream parlors and soda fountains, ...

State average number of gallons milk sold per month. ..... gallons.
State average number of gallons cream sold per month. ..... gallons.
State average number of gallons skimmed milk sold per month. ..... gallons.
Is the milk and cream which you sell delivered to you? ..... If so, give name of person from whom you receive the same. ..... Is he a retailer of milk? .....
If you produce your own milk, state average number of cows in your herd. .....
State number of Jerseys. ..... Grade Jerseys. .....
Number of Holsteins. ..... Grade Holsteins. .....
Number of Shorthorns. ..... Grade Shorthorns. .....
Number of Red Polled. ..... Grade Red Polled. .....
Number of cows of other breeds or common stock. .....
What is the number of persons employed in your dairy business? .....
Do you wholesale milk to others? ..... If so, give the names of all to whom you sell milk or cream. .....
Name, ... Street or P. O. address, ...
Name, ... Street or P. O. address, ...
Name, ... Street or P. O. address, ...
Name, ... Street or P. O. address, ...

APPLICATION FOR PERMIT.

NOTE.—When more than one wagon, depot, or store is operated, each should be numbered from one up to the number used.

..... 1901.

....., *State Dairy Commissioner, Des Moines, Iowa:*

..... hereby make application for ..... permit.. to sell milk in the city of ....., Iowa, for the year ending July 4, 1902. The following is a memoranda of each depot, store, or wagon under the management of the undersigned:

..... street.
Store or shop located at No ..... street.
Wagon No. 1 starts from No ..... street.
Wagon No. 2 starts from No ..... street.
Wagon No. 3 starts from No ..... street.
Wagon No. 4 starts from No ..... street.

Herewith find inclosed a draft, postal money order, or express money order to the amount of ..... dollars, for which please forward the number of permits enumerated above.

Signature: ....

NOTE.—In all cases $1 must accompany the application. This department will not assume or recognize any loss arising from remittances by cash or postage stamps.

All permits expire July 4 of each year.

Form to accompany application for milk license, Haverhill, Mass.

CITY OF HAVERHILL, OFFICE OF INSPECTOR OF MILK.

TO THE MILK DEALERS OF HAVERHILL:

Owing to the insanitary manner in which a great number of milk cows are kept and cared for, and the unwholesome and careless methods of some producers in obtaining and caring for milk at the time of milking and immediately thereafter, it becomes the duty of the inspector of milk to hereby notify you that all applicants for milk licenses to sell milk within the limits of the city of Haverhill for the year beginning May 1, 1900, are requested to have the producer from whom such milk is obtained fill out the following form:

Producer's name..... To what dealer do you sell your milk?..... How many cows in your possession?..... Have they been inspected within the last six months?

..... By whom?..... Give length of stable..... Give width of stable..... Give width from manger or "tie ups" to wall behind animals..... Give average height from floor to ceiling..... Number of windows facing north not obstructed ..... Size..... Number of windows facing south not obstructed..... Size ..... Number of windows facing east not obstructed..... Size..... Number of windows facing west not obstructed..... Size..... Is the stable open or closed in front of animals?..... Is the stable well lighted?..... Is the stable in basement or cellar?..... When is the stable cleaned?..... What is done with the manure?..... Is there a cellar under barn?..... Is the cellar open or closed? ..... Does the air in the stable seem good? or is it heavy or bad smelling?..... How is the stock watered?..... If from well, give its location in regard to barn cellar, manure yard, sink drain, privy vault, cesspool, or other source of possible contamination..... When is stock cleaned?..... What do you bed your milk cows on?..... Are they milked by clean and healthy attendants?..... Do you mix the milk from all your cows?..... How and where do you mix your milk?..... Are any of your cows sick or diseased at the present time?.....

Form for application to sell milk, New York City, N. Y.

38 G, 1899.

No.....

BOROUGH OF MANHATTAN.

APPLICATION (STORE) No. 1.

TO THE BOARD OF HEALTH OF THE DEPARTMENT OF HEALTH OF THE CITY OF NEW YORK:

The undersigned hereby applies for a permit to sell fresh and condensed milk in the city of New York, and makes the following statement in accordance with the laws, rules, and regulations of the board of health of the department of health of the city of New York:

FRESH MILK.

Name, ... Business, ... Location, ... Quarts sold per day..... From whom purchased [a] ..... Location, ... Time of delivery, ... Mark on can, ...

CONDENSED MILK.

From whom purchased,[a] ..... Location, ... Quarts sold per day, ... Time of delivery, ... Where is fresh or condensed milk kept during sale?..... How is ice box connected with sewer?..... Where located, ...

Signed, ...

Address, ...

Dated New York ....., 189..

This form to accompany preceding blank when applicable, New York City. N. Y.

FORM 123 C—1896.

No .....

SPECIAL INFORMATION BLANK No. 3.

Milk purchased or obtained from farmer, milk agent, creamery, condensary, or from farm belonging to applicant.

Name of milk agent, ... Residence, ... Name of farmer, owner of creamery or condensary, ... Town, ... County, ... State, ... Shipping

[a] If purchased or obtained from farmer, milk agent, creamery, condensary, or from farm belonging to applicant, fill in special information blank No. 3.

station, ... Railroad, ... County, ... State, ... No. of cans per day, ... Marks on cans, ... Time shipped, ... What milking shipped, ... Time in transit, ... No. of cows, ... Breed, ... Condition, ... Food, ... Housing, ... If in the city, ... Permit No..... Water supply for cows and where obtained, ...

Signed, ...
Address, ...

Dated New York, ..., 189..

Form for application to bring milk into the District of Columbia.

HEALTH DEPARTMENT, DISTRICT OF COLUMBIA,
Washington, ..., ...

SIR: The act to regulate the sale of milk in the District of Columbia provides that "no person shall bring or send into the District of Columbia for sale any milk without a permit so to do from the health officer of said District, and that such permits shall be issued subject to the following conditions:

That none but pure and unadulterated milk shall be, with knowledge of its impurity, brought into said District.

That in the management of the dairy farm upon which the milk is produced, or of the dairy at which the milk is collected and stored prior to shipment, the applicant shall be governed by the regulations of the health office of the District of Columbia, approved by the Commissioners of said District, issued for dairies and dairy farms in said District, when said regulations do not conflict with the law of the State in which said dairy or dairy farm is located.

The said dairy or dairy farm may be inspected at any time without notice by the health officer of the District of Columbia or his duly appointed representatives.

The veterinarian's certificate must be from one who has regularly graduated from a veterinary medical college, or who practices under a license from a State examining board. If unable to secure the services of such, so state on your application blank, and all other conditions being satisfactory, action will be suspended until this requirement is met, thus enabling you to send or bring milk into the District without violation of existing law.

If you desire to bring or send milk into the District of Columbia for sale, please fill out and sign the application below and forward it to the health officer without delay. Permits will be issued, without cost, as soon as possible after the receipt of the application.

The application for and acceptance of a permit necessarily carries with it the acceptance of the conditions specified above. A copy of the regulations referred to is inclosed herewith.

Respectfully,

WM. C. WOODWARD, M. D.,
Health Officer.

To .....
.....

APPLICATION FOR PERMIT TO SEND OR BRING MILK INTO THE DISTRICT OF COLUMBIA.

TO THE HEALTH OFFICER, D. C.

SIR: In compliance with "An act to regulate the sale of milk in the District of Columbia, and for other purposes," I hereby make application for a permit to send or bring milk into said District, from the premises described below, located ..... Number of shipments per day, ... Total number of gallons, ... whole milk, skimmed milk, cream. Shipped in wagon, ...; boat, ...; B. and O. R. R., ...; B. and P. R. R., ... Time of delivery, ... Place of delivery, ... Consigned to .....

DESCRIPTION OF PREMISES.

BUILDING.

Brick, ... Frame, ... stories high. Condition, ... Is any part of it used for any other than dairy purposes? ..... If so, specify, in the space for remarks, what parts of it are so used, and the purposes for which used.

Room for cattle.—Size, ... long, ... wide, ... high. Floor, kind, ...: condition, ... Is it properly sloped and guttered? ..... What disposition is made of the drainage? ..... Ventilation and lighting. How accomplished? ..... Windows. How many? ..... Location, ... Size, ... Are windows glazed? ..... Ventilators. How many? ..... Kind, ... Location, ... Size, ... Doors. How many? ..... Location, ... Stalls. Where located? ..... How many? ..... Size of each? ..... wide, ... long, ... wide, ... long. Are animals of any kind other than cattle kept in this room? ..... If so, specify how many and what kind. .....

Feeding troughs or boxes.—How many? ..... Kind, ... Location, ... Condition, ...

Water troughs.—How many? ..... Kind, ... Location, ... Condition, ... If water troughs are not used, how are cattle watered? .....

Source of water supply.—If from well, state location ..... Approximate depth ..... feet, and construction ..... Location of well with reference to nearest privy. State distance and slope of ground ..... Location of well with reference to place where dung is deposited. State distance and slope of ground ..... Has water any perceptible odor, color, or taste? ..... If so, describe .....

Receptacles for dung and other refuse.—How many? ..... Kind ..... Location ..... Condition .....

Receptacles for milk.—How many? ..... Kind ..... Condition ..... What provision is made for cleaning? ..... Is milk cooled immediately after milking? ..... If so, how? .....

BARNYARD.

Size ..... long ..... wide ..... Is it properly graded? ..... and drained? ..... Is it paved? ..... What disposition is made of the drainage? ..... What is its condition as to cleanliness, at time of inspection? .....

PASTURE.

Size of ..... Condition of ..... Is it supplied with drinking water for the cattle? ..... If so, from what source? .....

CATTLE.

How many milch cows are usually kept? ..... How many other cattle, if any, are kept in the same stable? ..... Kind of milch cows used ..... Condition of cows at time of inspection. General condition ..... Cleanliness, etc ..... Character of feed .....

PRIVY ACCOMMODATIONS.

How is human excreta from the premises disposed of? ..... Location of privy, if any? ..... Construction of privy .....

Signature of applicant: ....

Post-office address: ....

The above covers three pages of a four-page circular. On the last page provision is made for the certificate of the veterinarian who has examined the herd and premises described; also memoranda to appear on the outside fold when ready for filing. It is as follows:

.... *189*

To the Health Officer, D. C.

Sir: I have carefully examined the cattle upon the premises above referred to, and their condition is as follows: .....

Signature: ....
Address: ....

Personally appeared before me this ..... day of ..... 189., the subscriber, who, being duly sworn, deposes and says that he is a veterinary surgeon, practicing in accordance with the laws of the State in which he resides, and that he has personally examined the cattle referred to in the above statement and knows them to be the same as are referred to in the application to which the certificate is appended, and that their condition is correctly described without evasion or concealment.

Signature: ....
Address: ....

Forms containing all the above questions under "Description of premises" are used by inspectors for reporting conditions found on their visits.

Form for application to sell milk, Boston, Mass.

Application for License to Sell Milk in the City of Boston during the Year Ending May 31, 1900.

Name of applicant, ... Residence (street and number, town), ... Place of business, ... Number of wagons used in delivery of milk, ... Number of drivers employed, ...

Names of drivers.	Residences.
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....

Section supplied, ... Amount of milk raised (quarts), ... Number of cows kept, ... (If any, fill out Form 3.) Amount of milk bought (quarts), ... Of whom bought, ... Where delivered by him, ... Hour delivered, ... a. m.; ..... p. m. Where stored and handled after delivery, ... Whether mixed, handled, or stored where cows, horses, or other animals are kept, or where manure is stored, ... Whether mixed, handled, or stored in rooms used for domestic purposes or sleeping rooms, ... Location of milk room, ... How drained, ... Whether walls are tight and easily cleaned, ... Whether floor is tight and easily cleaned, ... Whether appliances are at hand for washing or sterilizing all utensils, ... Whether any water-closet, urinal, or privy is located in the room, ... Whether ice-box or refrigerator drained, and how, ...

The above is a correct statement.

Signature ....

Witness .....
Boston .....
License issued .....
Number of license .....

Form for report upon dairy and herd inspection in North Dakota.

STATE OF NORTH DAKOTA,
OFFICE OF ASSISTANT DAIRY COMMISSIONER,
OFFICIAL DAIRY AND HERD INSPECTION,
Date, ...

City, ... County, ... Location, ... Dairyman's name, ... P.O. address, ... No cows, ... No. license, ... Condition of cows (flesh), ... Condition of cows, sanitary, ... Condition of cows, apparent health, ... Condition of barn, ... Ventilation of barn, ... Condition of utensils, ... Kind of feed, ... Water, ... Where milk is kept, ... Method of delivery, ... Breed of cows, ... Tuberculin test, ... Remarks, ...

...., *Inspector.*

Form for report upon inspection of dairies, Erie, Pa.

INSPECTION OF DAIRY.

Date, ... Owner, ... Residence, ... Name of tenant, ... Location of dairy, ... No. of wagons, ... Section of city supplied, ... Examination of cows: No. clean, ... No. unclean, ... No. healthy, ... No. unhealthy, ... No. suspected, ... How fed in summer, ... How fed in winter, ... How watered, ... Disposition of at night, ... Stable: Material, ... size, ... how ventilated, ... drainage, ... No. of stalls, ... Disposition of manure: Temporary, ... permanent, ... Water supply: Source, ... distance from house, ... from stable, ... from privy, ...from manure pile, ... Milkers: No. male, ... No. female, ... No. healthy, ... No. unhealthy, ... Sickness in family, ... in neighborhood ..... Milk: Where stored, ... how long, ... in what, ... how cooled. ..... Remarks: .....

....
Inspector.

Form for report upon inspection for dairies, Salt Lake City, Utah.

DAIRY AND MILK REPORT.

....., 189.. 1. Name of dairy, ... 2. Permit No..... 3. Location, ... 4. Name of proprietor, ... 5. Post-office address, ... 6. Date of inspection. ..... 7. Average quantity of milk sold per day, ... 8. No. wagons, ... 9. No. cows, ... 10. Grade of cows, ... 11. No. acres of pasturage, ... 12. Condition of cows, ... 13. Condition of milking utensils and how cleaned. ..... 14. General appearance of milkers and other employes, ... 15. Water supply, ... 16. General sanitary condition, ... 17. Quantity and kinds of food: Hay—alfalfa, ... pounds per day; mixed, ... pounds per day. Bran, ... pounds per day. Shorts, ... pounds per day. Malts, ... pounds per day. Grains, ... pounds per day. Beet pulp, ... pounds per day. 18. Quality of milk, ... 19. Remarks.....

....., *Meat and Milk Inspector.*

Form for reporting conditions of dairies, Boston, Mass.

Statement of conditions under which cows are kept, and milk therefrom stored, on the premises of ....., at (town) ....., (State) ....., said milk being supplied by ..... to ....., for sale in the city of Boston, Mass.

STABLE.

Number of cows kept, ...; approximate air space per cow, ... Whether cow stable is well lighted, ... Whether cow stable is well ventilated, ... How drained, ... Condition of floor, ... Whether manure is stored in cellar, ... If not in cellar, where stored? .....

MILK ROOM.

Whether milk is cooled, mixed, or stored where cows or other animals are kept, or where manure is stored, ... Whether cooled, mixed, or stored in rooms used for domestic purposes or sleeping rooms, ... Location of milk room, ... Whether walls are tight and easily cleaned, ... Whether floor is tight and easily cleaned, ... Whether appliances are at hand for washing or sterilizing all utensils, ... Whether any water-closet, urinal, or privy is located in the room, ...

CONDITION OF COWS.

Date of last examination of cows, ... By whom examined, ... Number examined, ... Whether any cows were found to be diseased, ... Whether any cows have been added since; and if so, how many? ..... Whether added cows were examined; and if so, when and by whom? .....

SHIPMENT OF MILK.

Amount of milk shipped, ... To whom shipped, ... How shipped, ... Marks on cans, ...

The above is a correct statement.

Signature, ...
Address, ...

Witness, ...
Date, ...

Form for reporting conditions at dairies and methods of handling milk in New Jersey.

RECORD OF DAIRY INSPECTION.

BOARD OF HEALTH OF THE STATE OF NEW JERSEY,

....

1. Name of dairyman, ... (tenant—owner).
2. Post-office, township, county, ...
3. Location of dairy, ...

STABLE.

4. Size of stable, ...
5. Cubic feet per cow, ...
6. Stable well lighted? .....
7. Material, construction, and drainage of floor, ...
8. Method and frequency of cleaning, ...
9. Was stable clean at time of inspection? .....
10. Are side walls, ceilings, and ledges kept free from cobwebs and dust? .....
11. Ever lime washed? .....

WATER SUPPLY.

12. Sources of water supply for watering stock, ...
13. Sources of water supply for washing cans, bottles, and utensils, ...
14. Distance of well or spring from stable, ...

15. Distance from manure pile, ...
16. Distance from privy vault, ...
17. Distance from other sources of contamination, ...
18. Is well apparently liable to contamination? .....
19. Was sample of water taken for analysis? ..... 20. Marks, ...

CATTLE.

21. Number of cows, ... 22. Breed, ...
23. State of health, ...
24. Ever examined? ..... 25. By whom? .....
26. Date of last examination, ...
27. Were cows in a cleanly condition at time of inspection? .....
28. Amount, kind, and quality of feed used, ...
29. Cows pastured? .....

MANURE.

30. How and where stored? .....
31. How frequently removed? .....
32. Quantity of manure at time of this inspection, ...

UTENSILS.

33. How washed and dried? .....
34. Where are the utensils washed? .....
35. Any appliance for sterilizing cans, pails, and dippers? .....
36. Bottles—how washed and dried? .....

COLLECTION OF MILK.

37. Quantity of milk produced daily, ...
38. Are milkers' hands washed before milking? .....
39. Are clean garments put on? .....
40. Udders of cows cleaned? ..... 41. How? .....
42. When pail is full of milk what is done with it? .....
43. Where does the can stand? .....
44. Is can kept covered? .....
45. Is milk cooled? ..... 46. How? .....
47. How long after milking? .....
48. To what temperature? .....
49. Is milk bottled? .....
50. How long after cooling? .....
51. Where is milk bottled? .....
52. Where is milk stored? .....
53. How long is milk stored before being shipped? .....
54. Source of ice supply, ...
55. If shipped, to whom, and where? .....

DISTRIBUTION.

56. Temperature of milk when delivered to customers, ...
57. Quarts sold from cans, ...
58. Quarts sold in bottles, ...
59. Ever run short? .....
60. If so, where is supply obtained? .....
61. How many persons handle the milk? .....
62. All in good health? .....
63. Date of last sickness among persons on dairy premises, ...
64. Diseases, ...
65. Remarks, ...

....., *Inspector.*

Form for notice which must be sent to the inspector when cows are added to a dairy herd, Kansas City, Kans.

To Milk Producers:

Under the milk inspection ordinance it is made unlawful for anyone, after his dairy is inspected, to add any cows to his dairy, unless, within twenty-fours hours, he shall notify the inspector of such addition. In case you shall add any cows to your inspected dairy, please fill out the following statement and promptly send it to the inspector of licenses, weights, and measures, City Hall, Kansas City, Kans.:

To the Inspector of Licenses, Weights, and Measures:

I have this day added ..... cows to my dairy kept at ....., and I hereby declare the cows so added to said dairy are each and all in a healthy condition.

Sign here .....

Dairy Inspection No.....

Form for placing in quarantine cows suspected of having tuberculosis, North Attleboro, Mass.

Form No. 3*a*.—'95.

Order of Quarantine.

[Section 7, Chapter 491, Acts of 1894.]

ORIGINAL.

[To be delivered to owner or person in charge.]

☞ *To be used only for cows in milk suspected of being tuberculous.*

Town or city of ....., ..., 189..

To ....., owner (or person in charge):

You are hereby notified that, by virtue of the powers and authority in me vested by law, I have caused to be isolated and placed in quarantine in ..... upon your premises, to wit, ... the milch cow described as follows: ..... under suspicion of having the disease known as tuberculosis, a contagious disease under the law.

You and all other persons whom it may concern are hereby forbidden to remove the same from said place of quarantine for the purpose of slaughter or for any other purpose whatsoever, or otherwise to break said quarantine, until the further order of the local board of health, the cattle commission, or some one of its members.

You are notified that until this quarantine is removed said cow is deemed to be diseased. You are warned of the danger of using the milk therefrom, and are forbidden to sell or otherwise dispose of it in any market.

The Commonwealth will pay the actual expense of this quarantine which may be incurred after the tenth day, upon your returning to the board of cattle commissioners a satisfactory certificate of such expense.

[*Use a separate order for each animal.*]

....., *Inspector.*

READ THE OTHER SIDE.

(Note.—Upon the back of the form is printed in full the section of the law referred to above, relating to cattle quarantine.)

Form for milk-store permit, New York City, N. Y.

DEPARTMENT OF HEALTH, CITY OF NEW YORK,
New York, ..., 189..

Permit No. .....

..... is hereby authorized to sell milk, fresh and condensed, at No. ....., borough of Manhattan, under the laws, rules, and regulations of the board of health of the department of health of the city of New York.

This permit is not transferable to any person or location other than above, and must be kept posted at all times in a conspicuous place in this store, and is revocable at the pleasure of the board.

By order of the board of health.

[Signed by the president and secretary.]

Form for milk-wagon permit, New York City, N. Y.

39 G—1899.

DEPARTMENT OF HEALTH OF THE CITY OF NEW YORK,
BOROUGH OF MANHATTAN,

Permit No. ..... *New York, ..., 189..*

..... residing at ....., borough of ....., is hereby authorized to sell fresh and condensed milk from wagon No. ..... in the city of New York, under the laws, rules, and regulations of the board of health of the department of health of said city. This permit is revocable at the pleasure of the board.

By order of the board of health.

....., *President.*

....., *Secretary.*

Countersigned: .....

[Reverse side.]

This permit is void if used for any wagon except the one designated on the face.

Driver's name .....

Residence .....

Borough of .....

NOT TRANSFERABLE.

Form for notification that license to sell milk must be secured.—Newton, Mass.

CITY OF NEWTON, DEPARTMENT OF MILK INSPECTION.

The public statutes provide (chapter 57, section 4), that all persons before selling or offering for sale milk in any store, booth, stand, or market place in any city must be registered in the books of the milk inspector, and a license fee of fifty cents is required.

As you are reported as engaged in the sale of milk, and not registered, you are hereby notified that unless the provisions of the statute are complied with forthwith you will be complained of and liable to a fine not exceeding twenty dollars.

Please bring this notice with you.

Respectfully, ..., *Inspector of Milk.*

Form for dairymen's permit to sell milk, and stub for same, Los Angeles, Cal.

No. ..... Application No. .....
Date....., 190..

Name .....
Address .....
Name of dairy .....
Number of cows owned.....

Names and addresses of persons from whom milk is purchased.

.....
.....
.....
.....
.....
.....

Amount purchased daily.....gallons
Amount sold daily.....gallons
For the year ending April 30, 190..

DAIRYMEN'S PERMIT.

OFFICE OF THE BOARD OF HEALTH OF THE CITY OF LOS ANGELES, STATE OF CALIFORNIA,
Los Angeles, Cal.,.....190..

Permit No. .....

This certifies that ..... owner agent of ..... dairy, located at ..... has permission to sell milk in the city of Los Angeles for the year ending April 30, 190.., unless this permit shall be sooner suspended.

By order of the board of health.

....., *Health Officer.*

It is understood and agreed by the holder hereof that this permit is granted and accepted upon the express condition that it shall be subject to suspension for a period not exceeding six months by the said board of health, in its discretion, upon proof to the satisfaction of said board of a violation by the holder hereof, his servant or agent, of any of the provisions of ordinance No. ..... (new series), or upon proof of violation by said holder of any law of this State providing against the adulteration of milk or cream.

....

Form for license to sell milk, receipt for same, and stub for same, Boston, Mass.

No. ....
Date ....., 189..
Proprietor .....
Place of business .....
Number of carriages .....
Names of drivers .....
.....
.....
.....
Section supplied .....
No. of cans sold .....
No. of cans raised .....
No. of cows kept .....

POST THIS IN A CONSPICUOUS PLACE.

CITY OF BOSTON.

BUREAU OF MILK INSPECTION,
994 WASHINGTON STREET.
LICENSE TO SELL MILK No. ....

This certifies that ..... of ..... is licensed to sell milk in the city of Boston during the year ending May 31, 1900.

....., *Inspector of Milk.*

License issued ..... 1899.

NOTICE.—The licensee's name, place of business, and license number must be placed on each outer side of all vehicles used in the conveyance and sale of milk.

All changes of residence and of drivers must be immediately reported to the inspector.

Penalty for neglect of these provisions, not less than thirty dollars.

BOSTON, ... 1899.

Received of ..... inspector of milk, License (No. ...), to sell milk in the city of Boston for the year ending May 31, 1900.

....

Witness to signature .....

rm for notice to milk dealer to display license number on delivery wagons.—Minneapolis, Minn.

(ORIGINAL.)

MINNEAPOLIS, MINN., ..., 190...

Mr. .....

You are hereby notified that the law requires your name and location of dairy, ith number of your city license, upon each vehicle used by you in selling milk. Ten days' notice is hereby given you to comply with the law.

....., *Commissioner of Health.*

....., *Inspector.*

Forms for recording data regarding milk samples in Minnesota.

[Front.]

STATE DAIRY AND FOOD COMMISSION.

MILK FROM WAGON.

Date, ..., 189...

ne.....a. m. .....p. m.

me on wagon.....

- .....

ver in charge.....

ality.....

ether marked skimmed milk.....

of cans on wagon.....

ples taken from.....qt. can.

ense No. .....

on sample.....

BABCOCK TEST.

ap. .....

ecific gravity.....

t .....

mple delivered chemist.....189...

....., *Inspector.*

[Back.]

ANALYSIS.

Analysis No. .....
Specific gravity.....
Milk solids.....
Not fat.....
Fat.....
Ash.....
Milk sugar.....
Casein, etc. .....
Water.....
Water added.....
Color.....

REMARKS.

.....
.....
.....
.....
.....

Class.....

....., *Chemist.*

NOTE.—White cards are used for samples collected from wagons and yellow cards for samples llected from stores.

Form for recording data regarding milk samples.—Worcester, Mas

[This is printed on the two sides of a tag, to be attached to the sample bottle.]

CITY OF WORCESTER.

MILK.

Agent.....
Date.....
Time.....a. m.....p. m.
Town or city.....
Street.....

Wagon.
- Name on wagon.....
- License No. .....
- Driver in charge.....
- No. cans.....

Store.
- Proprietor of store or restaurant.....
- .....
- Of whom obtained.....
- Time of delivery at store.....
- Price sold at.....

Sample taken from.....quart can.....
.....marked "skimmed milk."
Other marks .....
.....
Duplicate sample sealed and delivered to
.....
Receipt taken .....
.....
Remarks.....
.....
.....
.....

CITY OF WORCESTER. MILK INSPE
DEPARTMENT, ROOM 2, CITY HAI

Result of analysis:
Solids not fat.....
Fat.....
Total solids.....
Water.....
Color.....
Specific gravity.....
Cream by volume.....
Remarks.....
.....
.....
.....
Notified by postal of result of test.

'orm for recording data regarding milk samples.—Newark, N. J.

tact duplicate of this form is attached to it, one copy to be given to the person from whom the s taken, the other to be retained by the officer.]

Original.

BOARD OF HEALTH, NEWARK, N. J.

....., 189...

Milk sample No. .....
Taken at.....
Date of taking sample....., 189...
Owner.....
Occupation.....
Address.....
Witness.....
Occupation.....
Address.....
Person sample taken from.....
Occupation.....
Address.....

LACTOMETER TEST.

Lactometer reading...Temp. reading...
Corrected reading.....
Sample delivered to.....
Chemist of the board of health on..189...
Remarks.....
.....
.....
.....
....., *Inspector.*

for recording data regarding preliminary inspections of milk, Philadelphia, Pa.

Date, ... Hour, ...
Street and number, ...
Name of owner, ...
Business, ...
From whom purchased, ...
P. O. address, ...

Can No.	Amount of contents.	Lactometer.	Temperature.	Lactometer at 60°.	Whole milk.	Skimmed milk.
1						
2						
3						
4						

No. of inspection .....
Mark .. on can, ...
REMARKS:
.....
.....
.....

Lact. reads ..... at .....°F. Action.....

Form for notification of the taking of a sample, Newark, N.

DEPARTMENT OF PUBLIC HEALTH, *Newark, N. J.*

To.....

DEAR SIR: I have taken a sample of milk for analysis from your sto street, on this ..... day of ....., and divided said sample into two placed each part in a suitable vessel, duly sealed and delivered, tendered at t such taking one part to you, ..., and in pursuance of the statute in made and provided (being the act of April 14, 1891). I deliver to you this in writing, and state that the cause of said sample having been taken is th milk contains more than eighty-eight (88) per centum of watery fluids an twelve (12) per centum of milk solids.

....

Milk I

Form for reporting analyses of milk samples, Worcester, Ma

[Printed on postal cards.]

CITY OF WORCESTER, DEPARTMENT OF MILK INSPECTION, ROOM 2, CITY

As per the provisions of chapter 169, acts of 1899, we notify you that th taken from ..... have shown the following:

Fat, ...
Solids, ...
Cream by volume, ...
Specific gravity, ...

....

Milk I

Form to be attached to a can from which milk has been spilled

otice of condemnation of milk and stub for same, Philadelphia, Pa.

[Stub for blank below.]

BOARD OF HEALTH, OFFICE OF CHIEF INSPECTOR OF MILK. CITY HALL, ROOM 513.

Philadelphia, ..., *190...*

No. .....

..... quarts (gallons.....) of milk condemned in the possession or custody of .....

Residence, ...

Sample delivered to.....

....., *Chief Inspector of Milk.*

per ....., *Asst. Inspector.*

HEALTH. OFFICE OF CHIEF INSPECTOR OF MILK. CITY HALL, ROOM 513.

Philadelphia, ..., *190...*

certify that I have this day inspected and condemned ..... quarts ...) of milk, in the possession or custody of ....., place of business, taken samples of same for examination and proof, one of which I have said ....., as required by ordinance.

....., *Chief Inspector of Milk.*

per ....., *Asst. Inspector.*

rm for recording inspection of milk depots, New Jersey.

HEALTH OF THE STATE OF NEW JERSEY. RECORD OF INSPECTION OF MILK DEPOT.

of inspection.]..... 2. [Name of place.]..... 3. [Name of dealer.] [Street and number.]..... 5. How is the milk stored?..... 6. How ottles, and utensils washed?..... 7. Any appliances for sterilizing cans, utensils?..... 8. Quantity of milk sold daily..... 9. Is can kept ... 10. How is milk cooled?..... 11. Temperature of milk when 12. Where is the regular supply of milk obtained?..... 13. When re is the supply obtained?..... 14. How many persons handle the . 15. Are all in good health?..... 16. Date of last sickness on prem- 17. Name of disease..... 18. Source of ice supply..... 19. Source pply..... 20. Was sample taken for analysis?..... 21. Marks.....

....., *Signature of Inspector.*

for recording inspection of stores, etc., Fall River, Mass.

OFFICE OF THE BOARD OF HEALTH, FALL RIVER, MASS.

INSPECTION OF STORES, BOOTHS, STANDS, ETC.

ilk is received, held, kept, bottled, canned, stored, or offered for sale by , of ..... (Made in accordance with the demands of an ordinance enti- ting to the sale of milk in the city of Fall River, Mass., and regulation No. oard of health of said Fall River.") Location of store, booth, or stand?

..... Description of store, booth, or stand? ..... Description of bottling or canning room? ..... Is license to sell milk conspicuously posted? ..... Approximate quantity of milk sold daily? ..... Provision for keeping the milk from contamination? ..... Condition of receptacle in which milk vessels and measures are kept? ..... Condition of milk cans and other vessels used? ..... Condition of measures used? ..... General sanitary condition of store? ..... Sanitary condition of surroundings? .....

SOURCE OF MILK SUPPLY.

Name.	Address.
.....	.....
.....	.....
.....	.....

NAME AND ADDRESS OF PERSONS TO WHOM MILK IS DELIVERED TO BE RESOLD.

.....	.....
.....	.....
.....	.....

Inspected, ..., 18...

....., *Inspector of Milk, for Board of Health.*

Form for record of inspections of wagons, etc., Fall River, Mass.

OFFICE OF THE BOARD OF HEALTH, FALL RIVER, MASS.

INSPECTION OF WAGONS, VEHICLES, ETC.,

Used to convey milk, or from which milk is sold or delivered by Mr. ....., of ..... (Made in accordance with the demands of an ordinance entitled, "Relating to the sale of milk in the city of Fall River, Mass., and regulation No. 71 of the board of health of said city.") Number of license? ..... Is name of licensee and number of license painted on wagon according to regulation 71? ..... Is license carried on the wagon? ..... Name and address of driver of wagon at time of inspection? ..... Approximate quantity of milk sold or delivered daily? ..... How much, if any, is sold to dealers to be resold? ..... Provision for keeping the milk from contamination? ..... Condition of receptacle in which milk vessels and measures are kept? ..... Condition of milk cans and other vessels used to hold milk? ..... Condition of milk measures and other utensils? .....

SOURCE OF MILK SUPPLY.

Name.	Address.
.....	.....
.....	.....
.....	.....

NAME AND ADDRESS OF PERSONS TO WHOM MILK IS DELIVERED TO BE RESOLD.

.....	.....
.....	.....
.....	.....

Inspected ....., 18...

....., *Inspector of Milk, for Board of Health.*

Forms for prohibiting and permitting the use of bottles, Yonkers, N. Y.

OFFICE OF THE BOARD OF HEALTH,
YONKERS, N. Y., ..., 189...

Mr. .....

DEAR SIR: You are hereby notified that there is a case of ..... in the family of ....., ... street, and that, in pursuauce of article 14, section 30, of the sanitary code, you will be required to discontinue the furnishing of receptacles for the delivery of milk into said family until you shall have been notified by this board that the danger from contagion is passed.

Respectfully,

....., M. D., *President.*

....., *Milk Inspector.*

OFFICE OF THE BOARD OF HEALTH,
YONKERS, N. Y., ..., 189...

Mr. .....

DEAR SIR: Permission is hereby given for the delivery of milk into the family of ....., ... street, in dealers' receptacles, as the danger from contagion on these premises has passed.

Respectfully,

....., M. D., *President.*

....., *Milk Inspector.*

Form for notification of violation of the law, Washington, D. C.

Any objection to this notice should be filed with the health officer before the expiration of the time allowed for making the changes specified.

No. .....

HEALTH DEPARTMENT, DISTRICT OF COLUMBIA.
DAIRY AND DAIRY FARM INSPECTION.

WASHINGTON, ...189...

Mr. .....

SIR: Your attention is called to the following violations of the regulations for the government of dairies and dairy farms, which have been found to exist upon your premises:

.....
.....
....

You are hereby notified to correct the same within ..... days from the date of service of this notice.

By order of the health officer.

....
Inspector of Dairies and Dairy Farms.

Form for warning against the sale of adulterated milk, Holyoke, Mass.

CITY OF HOLYOKE,
OFFICE OF INSPECTOR OF MILK, CORNER OF MAIN AND MOSHER STREETS,

No. .....

HOLYOKE, ..., 190—.

You are hereby notified that a sample of ..... marked ....., recently obtained from you was found on analysis to be adulterated. You are respectfully warned that the obtaining of another such sample will be followed by prosecution according to law.

Respectfully, yours,

....., *Inspector.*

Forms for keeping the records of the milk inspector's office by the "card system," Providence, R. I.

Time, ... Date, ...

MILK FROM STORE.

Proprietor's name .....
No. ..... street.
Milkman ..... Sample from.....
Clerk ..... No. on sample can.....
Can marked skimmed milk .....Seal.....
Sample sealed and delivered to ..... Whether measure marked.....
Collector ..... Whether at all frozen.....
Remarks .....
.....

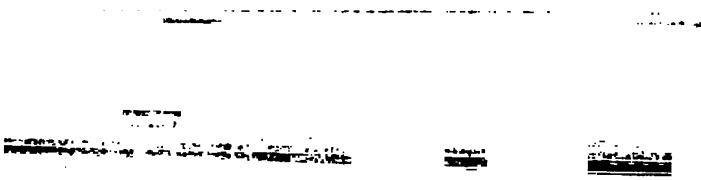
Name, ... Date, ...
Address..... Anal. No. .....
Milkman ..... Taken from.....
Sp. gr..... Milk sugar.....
Fat..... Casein.....
Total ..... Acidity.....
S. N. F .....Color, etc.....
Ash .....
Remarks .....
.....

No. ..... Name.....
Place of business.....
Store..... Bakery..... Restaurant..... Lunch cart.....
Milkmen .....
.....
Quantity week day ..... Sunday ..... Time delivered.....
Whether cream is sold ..... Whether skimmed milk is sold .....

The undersigned hereby makes application that his name be recorded in the inspector of milk's book as a milk dealer in the city of Providence, for the year ending February 1, 1901.

Signed .....
By .....

O



J. S. DEPARTMENT OF AGRICULTURE.
BUREAU OF ANIMAL INDUSTRY—BULLETIN NO. 47.
D. E. SALMON, D. V. M., Chief of Bureau.

HE HOG INDUSTRY.

SELECTION, FEEDING, AND MANAGEMENT.
RECENT AMERICAN EXPERIMENTAL WORK.
STATISTICS OF PRODUCTION AND TRADE.

BY

GEORGE M. ROMMEL, B. S. A.,
EXPERT IN ANIMAL HUSBANDRY, BUREAU OF ANIMAL INDUSTRY.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1904.

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
Washington, D. C., September 29, 1903.

SIR: I have the honor to transmit herewith the manuscript of an article entitled The Hog Industry: Selection, Feeding, and Management; Recent American Experimental Work; and Statistics of Production and Trade, by George M. Rommel, expert in animal husbandry, and to recommend the publication of the same as Bulletin No. 47 of this Bureau. In the compilation of the portion relating to American experimental work Mr. Rommel has consulted with Dr. C. F. Langworthy, of the Office of Experiment Stations, and in the preparation of that portion relating to statistics of production and trade in hogs, with the chief of the Bureau of Statistics, and for the valuable assistance thus obtained I desire to make acknowledgment. Our thanks are due Prof. Charles F. Curtiss, Director of the Iowa Experiment Station, for assistance.

The bulletin is a very comprehensive one, covering every phase of the subject, and it will be useful, it is believed, to the large number of persons engaged in the industry mentioned.

Respectfully,

D. E. SALMON,
Chief of Bureau.

Hon. JAMES WILSON, *Secretary.*

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SELECTION, FEEDING, AND MANAGEMENT.

THE HOG INDUSTRY.

By GEORGE M. ROMMEL, B. S. A.,
Expert in Animal Husbandry, Bureau of Animal Industry.

SELECTION, FEEDING, AND MANAGEMENT.

The hog has always occupied an important place in the animal husbandry of the United States. Unlike the supply of breeds of other kinds of live stock, the main dependence of American farmers for hogs has been placed upon breeds that have been developed on American soil. With a large native stock at hand, by selecting and feeding, blending strains and molding forms, American farmers may be said to have done for hogs what English farmers have done for the breeds of beef cattle and mutton sheep. Five distinct breeds have originated within that section of the country where corn is notably a feature in farming, viz, the Chester White in Pennsylvania, the Duroc Jersey in New Jersey and New York, the Poland China in Ohio and Illinois, the Victoria in New York and Indiana, and the Cheshire in New York. From the localities of their origin these breeds have been gradually disseminated over the entire country, the Poland China and Duroc Jersey having perhaps the widest distribution.

Coincident with the development of native breeds, the leading English breeds, particularly the Berkshire, have come into more or less popularity. The Berkshire has here the largest representation of foreign breeds, and are very nearly, if not quite, as generally distributed as the Poland China. With it have come the Essex (called Small Black, or Suffolk, in England),[a] the Large, Medium, and Small Yorkshire (generally called Large White, Middle White, and Small White in England),[b] and the Tamworth. A strain of white pigs known as Suffolks is somewhat general in this country, but good authorities consider it merely the Middle Yorkshire under another name. The real Suffolk pig is our Essex, in whose development Lord Western and Fisher Hobbs had so strong an influence.

[a] Spencer. Pigs: Breeds and Management, p. 15. [b] Idem, p. 5.

CONDITIONS SUITABLE FOR HOG RAISING.

The climate and soil which will best favor the production of any kind of live stock are those in which the same kind of stock is found wild. In his native state the hog frequents those localities where vegetation is abundant if not luxuriant. The climate is usually one of only moderate severity. If extremes either of heat or cold are common, the environment provides shelter in the dense thickets in winter and shade and an abundance of water in summer. He is a heavy and promiscuous feeder, and, therefore, in his domestic state he thrives best where pastures are most luxuriant and grain crops, nuts, or roots are most abundant. The hog is not a ranger, nor does he thrive on grass alone; he can not endure a great amount of travel at a time; exercise he must have, yet he must be able to find his feed with only a small amount of searching, and water should always be easily accessible. During hot weather he craves a pool of water to reduce his temperature, for he perspires little; and in winter he wants shelter from storms. Owing to these requirements there are few hogs in the semiarid States of the West, and in that section hog raising is coincident with irrigation and alfalfa growing.

The first place in hog raising in the United States is easily with the corn-growing sections, and here corn is the first grain thought of when the fattening of animals, especially hogs, is mentioned. It is, however, fallacious to argue that hog feeding will not give profitable returns outside of the corn belt. The corn belt has wonderful advantages for economical pork production, but it also has its disadvantages, one of which is the effect on fecundity of feeding too much corn to breeding stock. Any locality that will grow clover of any species, that is favorable to the production of alfalfa, peas, or beans, where grains are readily grown—not only corn, but barley, wheat, oats, or rye—will be a favorable situation for the successful production of pork. If it is a locality where dairying is common, no better advantages are required; for, given leguminous pasture—clover, alfalfa, peas, beans, etc.—as a basis, with a grain feed that can be readily grown and also dairy by-products, the very highest grade of pork can be produced at a minimum cost. Variety of feeds alone is an item of immense importance in feeding. An animal tires of a constant ration of one kind, and is more easily put "off feed" at such times than when he is occasionally supplied with a change to keep his appetite keen. Not only has variety of feed an influence on appetite, but it results in a better quality of pork.

The few States comprising the corn belt are in reality the source of supply for a great amount of the meat product, especially hams and bacon, that is consumed in other portions of the country. Yet the advantages of many of these corn-belt States are little, if at all, superior to those outside of that district. The South has an abundance of vegetation. Cowpeas, velvet beans, and peanuts are leguminous

crops that are peculiar to that section. Corn grows readily in all parts of the South, and in the subtropical portions the experience of feeders with cassava seems to indicate that it has considerable value for pork production. In addition, there is generally an abundant water supply; the climate is mild, and there is a long period during which green feed is available; the expense of shelter and winter feeding is very greatly lessened. These conditions, giving a long period of pasture and outdoor life, enhance thrift, and, with proper management, insure great freedom from disease.

In the extreme West the alfalfa of the irrigated valleys and the clover of the coast districts give a splendid foundation for successful pork production. In most of these regions there is an abundance of small grain, particularly barley, that may often be fed economically, while in some localities corn is a successful crop.

Barley is of so much interest to the experimenter, and its use is of so great importance in the production of prime pork, that it demands more than a passing notice. This grain has not been relied upon to a great extent in America as the principal part of a hog-fattening ration, but the practice of Danish farmers and the results of experiments can very well be studied with profit by American feeders. The Danish bacon, which figures so prominently in the English markets, is produced mainly with barley and dairy by-products. At the Ontario Agricultural College, Day has found barley so valuable in the production of prime export bacon that it is now used as a standard with which other grains are compared. In his experiments to determine the nature and causes of "soft" pork, Shutt found that the best bacon produced was by a ration in which barley was at least one-third of the whole amount. Farmers in those parts of the country where barley is a prominent crop can well devote attention to their opportunities for pork production; besides, in addition to this grain, some of the leguminous crops can often be grown for pasture, thus furnishing materials for a well-balanced ration.

The grain-growing districts of eastern Oregon and eastern Washington are instances of such localities. Corn is raised there to a very limited extent, but barley is an abundant crop and can be produced at minimum cost, and often wheat may be utilized. In nearly all parts of this section there are irrigated valleys where alfalfa grows abundantly. Yet every town and city in this section imports immense quantities of pork products from the corn belt; indeed, it has been stated that 75 to 90 per cent of all the hams and bacon sold at Spokane are shipped in from the East; and when one remembers that this city feeds a very great territory it is readily seen how great is the dependence on the corn belt.

The purpose of these remarks is not to minimize the value of corn in meat production of any kind. Corn is, perhaps, with a favorable climate and soil, the most economical grain that is at the command of the stock raiser and feeder of the United States. It is nutritious and

highly palatable. Without its use it is difficult to imagine how the animal products of the United States could have attained their present position in the world's commerce; and so long as meat products are a factor of American agriculture, corn will probably be a leading factor in meat production in this country, and the corn belt will naturally continue to be more or less the center of feeding operations. On the other hand, the condition is ever present that farmers in localities where corn is a limited product have their own wants to supply. If, in addition to their own needs, the farmers of these localities can supply a share of the export demand, great strides will have been taken in their agricultural development; for "live-stock husbandry is the foundation of successful agriculture." A market for the surplus is, of course, essential, but where a supply is available the market will probably grow up. The condition of the meat trade at present indicates that a strong market is assured for a very considerable time to come. The statistics presented herein show generally an increased trade both at home and abroad. The domestic consumption of all kinds of meats seems to be increasing, although the per capita amount can not be shown with accuracy. There is little reason to fear that the further development of the pork-producing interests of the United States will soon result in overproduction.

THE PROFITABLENESS OF HOG RAISING.

FECUNDITY.

The first feature of hog raising that appeals to farmers is the fecundity of the sows. No other meat-producing domestic animal, after poultry, is capable of producing so large a number of young in a year. The size of litters varies with breeds and with location and feed.

One of the effects of high corn feeding on breeding stock is the lessening of prepotency and fecundity. When the conditions of forage furnish a more or less varied diet, and consequently a better balanced ration, high fecundity may be expected. Free access to pasture will therefore always be a good practice with breeding sows. In addition to this, the number of hogs may almost be doubled by breeding the sows so as to produce two litters a year. The practice demands considerably more care on the part of the breeder than when breeding but once a year, and it should not be attempted unless the needed attention can be given at farrowing.

CHEAPNESS OF PRODUCTION.

Lawes and Gilbert[a] were the first investigators to make accurate determinations of the relative economy of meat production from the

[a] "On the composition of oxen, sheep, and pigs, and their increase whilst fattening," pp. 53–54.

various domestic animals. The summary of their studies on this subject is as follows:

(1) Fattening oxen, fed liberally upon good food, composed of a moderate proportion of cake and corn, some hay or straw chaff, with roots or other succulent food, and well managed, will on the average consume from 12 to 13 pounds of the dry substance of such mixed food per 100 pounds live weight per week, and should give 1 pound of increase for 12 to 13 pounds of dry substance so consumed. Sheep fattening under somewhat similar circumstances, but with a less proportion of hay and straw, will consume about 15 pounds of the dry substance of the mixed foods per 100 pounds live weight per week, and should yield, over a considerable period of time, 1 part of increase in live weight for about 9 parts of the dry substance of their food. If the food be of good quality, oxen and sheep may give a maximum amount of increase for a given amount of total dry substance of food, even provided the latter contain as much as 5 parts of total nonnitrogenous to 1 of nitrogenous compound.

(2) Pigs fed liberally upon foods composed chiefly of corn will consume from 26 to 30 pounds per 100 pounds live weight per week of the dry substance of such food. They should yield 1 part of increase in live weight for 4 to 5 parts of the dry substance of the food. They may give a maximum amount of increase for a given amount of dry substance of such food if it contain as much as 5 or even 6 parts of total nonnitrogenous to 1 of nitrogenous compounds.

These results have been corroborated repeatedly by American experimenters.

In their dressed weight hogs show less variation than cattle and about the same as sheep. The range between young pigs or poorly fattened animals and mature, finished hogs will be about 8 per cent—approximately 74 to 82 per cent of the live weight; with cattle the range is at least 15 per cent, between 55 per cent in the lowest returns of ordinary market animals and the high records of 70 per cent and over with stock-show winners. Sheep will vary approximately, depending on the age and condition, from 48 to 60 per cent.

HOGS AS SCAVENGERS.

The third benefit to be derived by the farmer from raising hogs comes from their eating waste products that would otherwise become a nuisance. Kitchen slops, the screenings from fanning mills, and the waste from thrashing machines can all be utilized in the pig yard; while the use of hogs in connection with beef production is frequently regarded by feeders as the principal source of profit. If hogs are raised in connection with dairying, pork of the highest quality may be produced. Dairy by-products (skim milk, buttermilk, and whey) agree with hogs especially well. Skim milk is especially valuable for pigs before weaning and during the earlier stages of feeding

after they are weaned. Its value with breeding stock is also very great. Whey is also valuable, though not so much so as skim milk. It should be fed carefully, for large amounts given continuously will cause a sort of rheumatic lameness in pigs.

Care must be taken in using hogs as scavengers. A good deal of stuff that finds its way to the hog lot should go to the garbage bank. Deleterious substances, such as lye, soap, glass, nails, etc., are very frequently in city swill, and such swill has been known to prove fatal when fed.

HOUSES, INCLOSURES, AND FENCES.

THE HOUSE AND ITS LOCATION.

Hogs are notably affected by extremes of heat and cold, and the character of their shelter will therefore depend on the locality. If the locality is one of severe winters, warm quarters are a necessity and an extensive piggery may be erected. Four things should be especially considered in its construction—(1) light, (2) ventilation, (3) warmth, and (4) cleanliness. Under cleanliness, ease of cleaning and dryness must be regarded. A well-drained location should be chosen. One that will give the hogs a good climb to reach it will provide needed exercise. The house should be on a north-and-south line, so that both sides may receive direct sunlight during a part of the day. Mr. John Cownie, of Iowa, recommends a house with a wide driveway, with pens 6 or 8 feet square on either side opening into the driveway, and each pen provided with a window for light and ventilation.[a] Mr. L. N. Bonham, of Ohio, recommends a house with a row of sleeping pens on either side of a cement-floored alley, opening into feed pens floored with cement. The sleeping pens are floored with boards laid in gravel or cinders. Paving brick cost about twice as much as cement.[b]

If no other means of ventilation than the windows are provided, they should be so arranged that entering air currents will be directed upward when the windows are opened and direct drafts on the hogs avoided. The size of the house and its equipment will depend upon the size of the herd and the resources of the owners. Not more than 50 breeding hogs should be confined in one house; sanitary considerations make a smaller number much safer. Out of doors the number of hogs in one inclosure may be increased considerably above 50 without danger.

Under any circumstances, the house should be well constructed and warm. If boarded up inside with good matched siding, such a house will be comfortable in zero weather and sows may farrow there with safety. Concrete or brick floors are expensive, but if the initial

[a] Thirteenth Biennial Report of Kansas State Board of Agriculture, p. 695.
[b] Breeder's Gazette, February 18, 1903.

expense can be incurred and the floors are well laid, they will pay good interest in the saving of manure and the dryness of the house. Animals should not be compelled to sleep directly on such floors, for rheumatism and colds are very likely to result. The best floor for a sleeping or farrowing pen is one of wood on concrete, the wood being 2-by-4 timbers, laid from one-fourth to three-eighths inch apart to allow drainage. If not constructed in this way, concrete and brick floors should be kept well littered. A clay or ordinary earth floor is excellent, and by some preferred to any other. It is the warmest floor, but not so easily kept clean as one of brick or concrete. If a house is constructed with earth floors, care must be taken that they are well drained, both underground and on the surface. The greatest necessity for a good house is at farrowing time, for it is then that more pigs die than at any other. If the sow farrows in a damp or cold place or in drafts, serious results to the sow or the pigs or to both will follow. At this time the sow is seriously weakened and she is very susceptible to exposure, while new-born pigs are easily stunted or killed by chilling. Rheumatic complaints are common with pigs and are often caused by damp, chilly sleeping places.

PORTABLE HOUSES.

The portable house is coming into very general favor, especially in disease-infested districts. They are of various forms and should be large enough for five or six grown hogs, with enough height to allow a man to stand erect; 6 by 6 feet or 8 by 8 feet are good sizes. Such houses should be strongly constructed of good lumber, with perfectly tight siding and roof. They are generally made without floors. If lined inside with the same materials as outside, such a house will be warm enough for a sow and pigs in zero weather.

A chief advantage of a portable house over the piggery system of several pens and a large number of hogs under one roof is its ease of management in times of epidemic. Only a few animals may be kept in one pen, and the isolation of the diseased animals when an outbreak begins is thus rendered comparatively easy. When cholera breaks out in a crowded piggery, every animal in the building is exposed, and the farmer, though he may isolate the unaffected animals at once, does not know how soon the second outbreak will occur; he has no check whatever on the epidemic. But with portable hog houses each house is itself a cholera check and only infection directly from diseased animals can spread the disease.

HOUSING IN MILD CLIMATES.

In the South and in much of the country west of the main chain of the Rocky Mountains the winters are sufficiently mild to obviate the necessity of constructing buildings of much warmth. Not only are

the winters mild, but they are comparatively short, and green feed is available much longer than in other parts of the country. In such localities a shed will often suffice, but it should be well constructed in order to provide protection from storms and damp, chilly weather. The location, as that of a piggery, should be high and well drained, affording clean, dry sleeping places; the shed should open to the south. The expense of such a building is well warranted in view of the added comfort to the stock and increased number of pigs raised. Under all circumstances, regardless of climate, whether a man is breeding purebred stock or grades, hogs should have sleeping places that are dry and warm and feeding places that are clean.

PENS AND PASTURES.

The question of pens and pastures, both as to size and location, must be determined by each one for himself. Local conditions, expense, and convenience must be considered. A good rule to follow is to favor large inclosures rather than small ones. A number of pens and several pastures will be found a convenience and are particularly valuable when disease makes its appearance, as hogs affected may then be removed at once. A quarantine pen with an absolutely tight fence should be arranged on every farm where hogs are kept. Here all new-purchased hogs should be confined after arriving at the farm until all danger of infection is past.

It will generally be a satisfactory practice to keep hogs away from other stock, except when following fattening steers. Pregnant brood sows should never be allowed to run in the same yards or pastures with cattle, horses, or mules. Many good sows have been ruined by the playfulness or viciousness of the larger farm animals.

The pen and yard for the boar should be separate from the rest of the herd and out of sight of it. The pen should be so strong that the boar can not tear it down or go through it, and a tightly fenced pasture of one-half to 1 acre in area should adjoin.

A "down"[a] pigging sow, if she is to farrow in the piggery, can have the run of the alley for exercise. If she has a house to herself, a small yard should adjoin.

FENCING.

No man should attempt to raise hogs without adequate fencing of yards and pastures. An animal of any kind, but especially a hog, can make himself an intolerable nuisance if not confined within proper bounds. For pastures woven wire is the best fencing material, all things considered. Such a fence may be purchased ready-made or may be made on the farm by machines. There are several good kinds on the market. From motives of economy, it may be desired to run a fence of woven wire around a field to a height of 30 to 36 inches, and above this to stretch two or three strands of ordinary

[a] A sow about to farrow.

barb wire. This will make a hog-tight fence, and if horses are necessarily placed in the field the fence will be much safer than the ordinary one made entirely of barb wire. Midway between the posts the lower strand in the fence should be securely stapled to a small post or stake; this will prevent hogs from working their way under the fence. In building any kind of wire fence ground wires may be put down to moisture at frequent intervals to give stock protection from lightning.

A board fence makes, perhaps, the most secure inclosure for hogs, but its expense precludes its use generally except for yards and pens. These should always be of boards, stoutly nailed to strong, well-set posts.

Barb wire is very poor material for a hog fence. It can hardly be made close enough or strong enough to prevent a shoat from crawling through. In this respect it is only a little better than a hedge, which is expensive and unsatisfactory when used to confine stock. Gates must, of course, be carefully made, hung, and fastened.

SELECTION OF BREEDING STOCK.

THE BREED.

The question of breed, though agitated to a less extent at present than during ordinary years, is, nevertheless, complicated and will continue to be so as long as man eats meat. Each breed has its merits, and family attachments, personal preferences, and the influence of environment will never fail to create strong and healthy partisanship for each breed of established reputation. However, in actual practice, the man who feeds for the market recognizes, not breed, but type. His selections may be made promiscuously from among the available material, but all are required to conform to a certain standard, which, when fattened, is the hog demanded by the market; for with all meat-producing animals the stock that is fed for market must conform to market requirements to return a profit to the feeder. Therefore if they are to maintain their standing the breeds that produce these animals must be managed so that their produce will meet the market demands, and thus the market qualifications become the standard, not only for a few breeds, but for all. This is particularly noticeable in the case of the breeds of beef cattle and hogs.

SIMILARITY OF TYPE IN DIFFERENT BREEDS.

Among breeds of hogs, therefore, differences between the breeds will be noticed principally in details. For example, the advocates of one breed want a hog with a deeply dished face, a short nose, and an erect ear. Such are the Berkshire breeders. Breeders of Poland Chinas do not breed for so great a dish in the face nor for so short a nose, and usually take an ear that is "broken" about one-fourth its

length from the tip. In their color requirements the breeders of both prefer black with six white points (feet, face, and brush of tail). Again, Duroc Jersey and Chester White breeding hogs show even closer similarity of individuals than Berkshires and Polands, but are readily distinguishable by the characteristic colors. But on the points that represent the real meat-yielding parts of the animals the standards are almost identical. Breeders look for quality, depth, length, and width of form and depth and condition of flesh, regardless of whether their hogs are black, red, or white.

At first sight breeds of the bacon type seem to be exceptions to this rule, but as yet there is not in the United States what can be called a general market class for hogs of this type. Packers explain this by saying that the scarcity of supplies of bacon hogs precludes their distinction as a separate market class. At present (1902) the hog that sells for the highest price on the markets of the central West is the hog of the lard type. Nevertheless, competent authorities are strongly of the opinion that the consumer's demand in the not far distant future will undergo a change and require a cut of pork that contains relatively more lean and less fat. If the public demand changes, the prices paid by packers will show a discrimination in favor of such an animal and the type will change. Such a transformation has taken place in the hog of England during the past twenty-five years; also in both England and America the highest type of steer demanded by the market has been changed from a huge fat 3-year-old, weighing up to 2,000 pounds, to the small handy-weight steer, weighing from 1,200 to 1,600 pounds. The possibility of a change in our hog type is apparent, but if it comes it will hardly result in supplanting any of the native breeds of this country. Their hold on the soil and the natural plasticity of conformation of the hog will cause American breeders to bring their standards to conform to market requirements. Prejudices will be cast aside, markets will be studied, rigid selection practiced. All animals that do not show the proper conformation will be eliminated from the breeding herd until the new conditions have been met. In any case the argument holds that the breed standards are molded by market qualifications and that the ideals of all breeds tend to converge into a common type.

How closely the breeds conform to a common standard may be seen by a perusal of the following comparative score card:

COMPARATIVE SCORE CARD OF FIVE BREEDS OF HOGS OF THE LARD TYPE.

[Compiled from the score cards of the National Association of Expert Judges on Swine.]

DETAILED DESCRIPTION.

HEAD.

Poland China.—Head broad, even, and smooth between and above the eyes; slightly dished, tapering evenly and gradually to near the end of the nose; inclined to shortness, but not enough to give the appearance of stubby nose; in male a *masculine* expression and appearance; broad lower jaw.

Berkshire.—Head short, broad, coming well forward at poll; face short and fine and well dished, broad between the eyes, tapering from eyes to point of nose, surface even and regular.

Duroc Jersey.—Head small in proportion to size of body, wide between eyes; face nicely dished (about half way between a Poland China and a Berkshire) and tapering well down to the nose, surface smooth and even.

Chester White.—Head short and wide; cheeks neat but not too full; jaws broad and strong; forehead medium, high, and wide; face short and smooth, wide between the eyes; nose neat and tapering and slightly dished.

Victoria.[a]—Head rather small and neat; face medium, dished, and smooth, wide between eyes, and tapering from eyes to nose.

Objections.

Poland China.—Head long and narrow between the eyes; nose uneven and coarse; too large at the muzzle or head too short; not full or high above the eyes or too much wrinkled around or above the eyes.

Berkshire.—Head long, narrow, and coarse; forehead low and narrow; jaws narrow or contracted; lower jaw extending beyond upper; face long and straight between eyes; nose coarse, thick, or crooked or ridgy.

Duroc Jersey.—Head large and coarse, narrow between the eyes; face straight; nose crooked or too much dished.

Chester White.—Head long, narrow, and coarse; forehead low and narrow; jaws contracted and weak; face long, narrow, and straight; nose coarse, clumsy, or dished like a Berkshire.

EYES.

Poland China.—Full, clear, prominent, and expressive.

Berkshire.—Very clear, rather large, dark hazel or gray.

Duroc Jersey.—Lively, bright, and prominent.

Chester White.—Large, bright, clear, and free from wrinkles of surrounding fat.

Victoria.—Medium size, prominent, bright, clear, and lively in young and of quiet expression in aged animals.

Objections.

Poland China.—Dull of expression, deep set, or obscure; sight impaired by wrinkles, fat, or other cause.

Berkshire.—Small, dull, bloodshot, deep set, or obscure; sight impaired by wrinkles, fat, or other causes.

Duroc Jersey.—Dull, weak, and obscure.

Chester White.—Small, deep, or obscure; sight impaired in any way.

EARS.

Poland China.—Ears attached to the head by a short, firm knuckle, giving free and easy action; standing up slightly from the base to within two-thirds of the tip, where a gentle break, or drop, should occur; in size neither too large nor too small, but even, fine, thin, leaf shape; slightly inclined outward.

Berkshire.—Generally almost erect, but sometimes inclined forward with advancing age; medium size, thin, and soft.

Duroc Jersey.—Medium, moderately thin, pointing forward, downward, and slightly outward, carrying a slight curve; attached to head very neatly.

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[a] The Victoria standard is that of the Victoria Swine Breeders' Association, but it has been adopted by the Association of Expert Judges for their use and is published along with their own score cards.

Chester White.—Medium size, not too thick, soft; attached to the head so as not to look clumsy; pointing forward and slightly outward; fully under control of the animal; drooping so as to give a graceful appearance.

Objections.

Poland China.—Large, floppy, straight, upright, or coarse; knuckle long, letting the ear drop too close to the head and face, hindering the animal in their free use.

Berkshire.—Large, coarse, thick, round, or drooping; long or large knuckle; difference in form or position from each other; animal unable to control their position.

Duroc Jersey.—Very large, nearly round, very thick, swinging, or flabby; not of same size; differing in position, and not under control of animal.

Chester White.—Large, upright, coarse, thick, round, too small, dropping too close to the face; animal unable to control them.

NECK.

Poland China.—Short, wide, even, smooth, well arched; rounding and full from poll to shoulder, with due regard to the characteristics of the sex.

Berkshire.—Full, deep, short, and slightly arched, broad on top, well connected with shoulder.

Duroc Jersey.—Short, thick, and very deep and slightly arching.

Chester White.—Wide, deep, short, and nicely arched.

Victoria.—Medium wide, deep, short, well arched, and full at top.

Objections.

Poland China.—Long, narrow, thin, and drooping from the shoulder to the poll, with unevenness caused by wrinkles or creases.

Berkshire.—Long, flat, lacking in fullness and depth.

Duroc Jersey.—Long, shallow, and thin.

Chester White.—Long, narrow, thin, flat on top, tucked up, not extending down to the breastbone.

JOWL.

Poland China.—Full, broad, deep, smooth, and firm, carrying fullness back near to point of shoulders, and below line of lower jaw, so that lower line will be as low as breastbone when head is carried up level.

Berkshire.—Full, firm, and neat, carrying fullness back to shoulder and brisket.

Duroc Jersey.—Broad, full, and neat, carrying fullness back to point of shoulders and on a line with breastbone.

Chester White.—Full, smooth, neat, and firm, carrying fullness back to shoulder and brisket when the head is carried up level.

Victoria.—Medium full, nicely rounded, neat, and free from loose, flabby fat.

Objections.

Poland China.—Light, flabby, thin, and wedge shaped; deeply wrinkled, not drooping below line of lower jaw, and not carrying fullness back to shoulder and brisket.

Berkshire.—Light, flabby, thin, tucked up or wrinkled.

Duroc Jersey.—Too large, loose, and flabby; small, thin, and wedging.

Chester White.—Light, too large and flabby, rough, and deeply wrinkled; not carrying fullness back to shoulder and brisket.

SHOULDERS.

Poland China.—Broad and oval at the top, showing evenness with the back and neck, with good width from the top to the bottom, and even smoothness, extending well forward.

Berkshire.—Broad, deep, and full; not extended above line of back, and as wide on top as back, carrying size down to line of belly, and having lateral width.

Duroc Jersey.—Moderately broad, very deep and full, carrying thickness well down and extending above line of back.

Chester White.—Broad, deep, and full, extending in a straight line with the side, and carrying size down to line of belly.

Victoria.—Broad, deep and full; not higher than the line of back and as wide on top as back.

Objections.

Poland China.—Narrow at the top or bottom, not so deep as the body, uneven width; shields on pigs under eight months of age, or showing too much shield at any age.

Berkshire.—Lacking in depth or width; thick beyond the line of sides and hams or extending above line of back; heavy shields on hogs under eighteen months of age.

Duroc Jersey.—Small, thin, shallow, extending above line of back; boars under one year old heavily shielded.

Chester White.—Narrow at top or bottom; not full nor same depth as body, extending above line of back; shields on boars too coarse and prominent.

CHEST.

Poland China.—Large, wide, deep, and full; even underline to the shoulder and sides, with no creases; giving plenty of room for heart and other organs, making a large girth, indicating much vitality. Brisket smooth, even, and broad; wide between the legs, and extending well forward, showing in front.

Berkshire.—Large, wide, deep, and roomy; full girth; breast bone curving well forward, extending back on level; not tucked up; broad between fore legs.

Duroc Jersey.—Large, very deep, filled full behind shoulders; breast bone extending well forward so as to be readily seen.

Chester White.—Large, deep, and roomy so as not to cramp vital organs; full in girth around the heart; the breast bone extending forward so as to show slightly in front of legs and let down so as to be even with line of belly, showing a width of not less than 7 inches between fore legs of a full-grown hog.

Victoria.—Large, wide, deep, and roomy, with large girth back of shoulders.

Objections.

Poland China.—Pinched appearance at the top or bottom, or tucked in back of the fore legs; showing too narrow between the legs; not depth enough back of the shoulder; brisket uneven, narrow, not prominent.

Berkshire.—Flat, narrow at top or bottom, small girth, lacking depth or fullness; breast bone crooked or tucked up.

Duroc Jersey.—Flat, shallow, or not extending well down between fore legs.

Chester White.—Narrow, pinched, heart girth less than flank girth, too far let down between fore legs, breast bone crooked or too short.

BACK AND LOIN.

Poland China.—Broad, straight, or slightly arched, carrying same width from shoulder to ham; surface even, smooth, free from lumps, creases, or projections; not too long but broad on top, indicating well-sprung ribs; should not be higher

at hip than at shoulder and should fill out at junction with side, so that a straight-edge placed along at top of side will touch all the way from point of shoulder to point of ham; should be shorter than lower belly line.

Berkshire.—Broad and straight, carrying same width from shoulder to ham; surface even and smooth without creases or projections, and not too long.

Duroc Jersey.—Back medium in breadth, straight or slightly arching, carrying even width from shoulder to ham; surface even and smooth.

Chester White.—Back broad on top, straight or slightly arched, uniform width, smooth, free from lumps or rolls, shorter than lower belly line, same height and width at shoulders as at ham; loin wide and full.

Victoria.—Broad, straight, or slightly arched, carrying same width from shoulders to ham, level and full at loin, sometimes higher at hip than at shoulder.

Objections.

Poland China.—Narrow, creased back of shoulders, swayed or hollow, dropping below a straight line; humped or wrinkled; too long or sunfish shape; loin high, narrow, depressed, or humped up; surface lumpy, creased, ridgy, or uneven; width at side not so great as shoulder and ham.

Berkshire.—Narrow, swayed, or hollow, dropping below a straight line.

Duroc Jersey.—Narrow, creased behind shoulders, swayed or humpbacked.

Chester White.—Back narrow, creased back of shoulders, sunfish shape, humped, swayed, too long or lumpy rolls, uneven in width; loin narrow, depressed, or humped.

SIDES AND RIBS.

Poland China.—Sides full, firm, and deep, free from wrinkles, carrying size down to belly; even from ham to shoulder; ribs of good length, well sprung at top and bottom.

Berkshire.—Sides full, smooth, firm, and deep, carrying size down to belly; even from ham to shoulder; ribs long, strong, well sprung at top and bottom.

Duroc Jersey.—Sides very deep, medium in length, level between shoulders and hams and carrying out full down to line of belly; ribs long, strong, and sprung in proportion to width of shoulders and hams.

Chester White.—Sides full, smooth, deep, carrying size down to belly, even with line of ham and shoulder; ribs long, well sprung at top or bottom, giving the hog a square form.

Victoria.—Ribs well sprung at top, strong, and firm; sides deep, full, smooth, and firm, free from creases.

Objections.

Poland China.—Flat, thin, flabby, pinched, not as full at bottom as at top; drawn in at shoulder so as to produce a crease, or pinched and tucked up and in as it approaches the ham; uneven surface; ribs flat or too short.

Berkshire.—Flat, thin, flabby, not so full at bottom as at top; ribs weak; not well sprung at top or bottom.

Duroc Jersey.—Flabby, creased, shallow, and not carrying proper width from top to bottom.

Chester White.—Flat, thin, flabby, compressed at bottom, shrunken at shoulder and ham; uneven surface; ribs flat and too short.

BELLY AND FLANK.

Poland China.—Belly broad, straight, and full, indicating capacity and room, being about the same or on a level at the flank with the underline of the chest. Underline straight, or nearly so, and free from flabby appearance.

Berkshire.—Wide, full, and straight on bottom line.

Duroc Jersey.—Straight and full and carrying well out to line of sides; flank well down to lower line of sides.

Chester White.—Same width as back, full, making a straight line, and dropping as low at flank as at bottom of chest; line of lower edge running parallel with sides; flank full and even with body.

Victoria.—Wide, straight, and full; as low or slightly lower at flank than at chest; flank full and nearly even with the sides.

Objections.

Poland China.—Belly uneven and flabby or apparent looseness in the make-up; pinched up in the flank or flanked too high.

Berkshire.—Belly narrow and sagging; flank thin and tucked up.

Duroc Jersey.—Narrow, tucked up or drawn in, sagging, or flabby.

Chester White.—Belly narrow, pinched, sagging, or flabby; flank thin, tucked up, or drawn in.

HAMS AND RUMP.

Poland China.—Hams broad, full, deep, and long from rump to hock. Fully developed above and below, being wide at the point of the hip, carrying width well down to the lower part of the hams; fleshy, plump, rounding fullness perceptible everywhere; rump rounding and gradually sloping from the loin to the root of the tail; broad and well developed all along from loin and gradually rounding to the buttock; lower front part of ham should be full, and stifle well covered with flesh; even width of ham and rump with the back, loin, and body; even a greater width as to females, not objectionable.

Berkshire.—Hams broad, full, and long; the lower front part of ham should be full and stifle well covered with flesh, coming well down on hock; rump should have a rounding slope from loin to root of tail, same width as back, and filling out on each side and above the tail.

Duroc Jersey.—Broad, full, and well let down to the hock; buttock full and coming nearly down and filling full between hocks; rump should have a round slope from loin to root of tail, same width as back, and well filled out around tail.

Chester White.—Ham broad, full, wide, long, and deep, admitting of no swells; buttock full, neat, and clean, thus avoiding flabbiness; stifle well covered with flesh, nicely tapering toward the hock; rump should have a slightly rounding shape from loin to root of tail, same width as back, making an even line with sides.

Victoria.—Hams long, full, wide, nicely rounded, trim, and free from fat; buttocks large and full, reaching well down toward hocks; rump slightly sloped from end of loin to root of tail.

Objections.

Poland China.—Ham short, narrow, too round, or too slim; not filled out above or below, or unshapely for deep meat; not so wide as the body; back or loin too tapering or small; rump narrow or pointed, not plump or well filled, or too steep from loin to the tail.

Berkshire.—Ham narrow, short, thin, not projecting beyond and coming down on hock; cut up too high in crotch; rump flat, narrow, or too steep.

Duroc Jersey.—Ham narrow, short, thin, not projecting well down to hock; cut up too high in crotch; rump narrow, flat, or peaked at root of tail, or too steep.

Chester White.—Ham narrow, short, not filled out to stifle, too much cut up in crotch or twist, not coming down to hock; buttocks flabby, rump flat, narrow, too long, too steep, sharp or peaked at root of tail.

LEGS AND FEET.

Poland China.—Legs medium length, straight, set well apart and squarely under body, tapering, well muscled and wide above knee and hock; below hock and knee, round and tapering, capable of sustaining weight of animal in full flesh without breaking down; bone firm and of fine texture; pasterns short and nearly upright; feet firm, short, tough, and free from defects.

Berkshire.—Legs short, straight, and strong, set wide apart with hoofs erect and capable of holding good weight.

Duroc Jersey.—Medium size and length, straight, nicely tapered, wide apart, and well set under the body; pastern short and strong; feet short, firm, and tough.

Chester White.—Legs short, straight, set well apart and squarely under body; bone of good size; firm, well muscled, wide above knee and hock; below knee and hock round and tapering, enabling the animal to carry its weight with ease; pastern short and nearly upright; feet short, firm, tough, and free from defects.

Victoria.—Legs short, set well apart and firm, wide above knee and hock, tapering below; feet firm and standing well up on toes.

Objections.

Poland China.—Legs long, slim, coarse, crooked; muscles small above hock and knee; bone large, coarse, as large at foot as above knee; pasterns long, slim, crooked, or weak; the hocks turned in or out of straight line; legs too close together; hoofs long, slim, and weak; toes spreading or crooked or unable to bear up weight of animal without breaking down.

Berkshire.—Legs long, slim, coarse, crooked; muscles light, pastern long, slim, or flat; feet long or sprawling.

Duroc Jersey.—Legs extremely long or very short, slim, coarse, crooked; as large below knee and hock as above, set too close together; hocks turned in or out of straight line; feet, hoofs long, slim, and weak toes, spreading or crooked.

Chester White.—Legs too short, long, slim, crooked, too coarse, too close together; weak muscles above hock and knee; bone large and coarse, without taper; pastern long, crooked, slim, like a deer's; hoofs long, slim, weak; toes spreading, crooked, or turned up.

TAIL.

Poland China.—Tail of medium length and size, smooth, and tapering well and carried in a curl.

Berkshire.—Set well up, fine, tapering, and neatly curled.

Duroc Jersey.—Medium, large at base and nicely tapering and rather bushy at end.

Chester White.—Small, smooth, tapering, well set on, root slightly covered with flesh, carried in a curl.

Victoria.—Small, fine, and tapering, nicely curled.

Objections.

Poland China.—Coarse and long without a curl; or short, crooked, or stubby; or too small, fine, even, not tapering.

Berkshire.—Coarse and straight, too low.

Duroc Jersey.—Extremely heavy, too long, and ropy.

Chester White.—Coarse, long, clumsy, set too high or too low, hanging like a rope.

COAT.

Poland China.—Fine, straight, smooth, lying close to and covering the body well; not clipped; evenly distributed over the body.

Berkshire.—Fine, straight, smooth, lying close to and covering the body well; not clipped; evenly distributed over the body.

Duroc Jersey.—Moderately thick and fine, straight, smooth, and covering the body well.

Chester White.—Fine, straight, or wavy, evenly distributed, and covering the body well; nicely clipped coat no objection.

Victoria.—Fine and silky, evenly covering the body.

Objections.

Poland China.—Bristles, hair coarse, harsh, thin, wavy, or curly; swirls, standing up, ends of hair split and brown, not evenly distributed over all of the body except belly; clipped coat should be cut 1.5 points.

Berkshire.—Hair coarse, harsh, wavy or curly, not evenly distributed over body; swirls or clipped.

Duroc Jersey.—Too many bristles, hair coarse, harsh, and rough, wavy or curly; swirls or not evenly laid over the body.

Chester White.—Bristles, hair coarse, thin, standing up, not evenly distributed over the body, except the belly.

COLOR.

Poland China.—Black with six white points—tip of tail, four white feet, and white in face, on the nose or on the point of lower jaw—all to be perceptible without close examination; splashes of white on the jaw, legs, or flank, or a few spots of white on the body not objectionable.

Berkshire.—Black, with white on feet, face, tip of tail, and an occasional splash on arm.

Duroc Jersey.—Cherry red without other admixtures.

Chester White.—White (blue spots or black specks in skin shall not indicate impurity of blood).

Victoria.—White, with occasional dark spots on skin.

Objections.

Poland China.—Solid black, white mixed or sandy spots; speckled with white hairs over the body; mottled face of white and black; hair mixed, making a grizzly appearance.

Berkshire.—Solid black or black points, or white spots on body.

Duroc Jersey.—Very dark red or shading brown, very pale or light red, black spots over the body, black flecks on belly and legs not desired, but admissible.

Chester White.—Color any other than white.

SIZE.

Poland China.—Large for age; condition, vigor, and vitality to be considered. There should be a difference between breeding animals and those kept or fitted for the show of at least 25 per cent in size. In show condition, or when fat, a 2-year-old boar should not weigh less than 600 pounds, and a sow not less than 500 pounds; boar 1 year and over, 400 pounds; sow, 350 pounds; boar 18 months' old, 500 pounds; sow, 450 pounds; boars and sows 6 months' old, not less than 160 pounds; all hogs in just fair breeding condition, one-fourth less for size. The keeping and chance that a young hog has cuts quite a figure in his size and should be considered, other points being equal. Fine quality and size combined are the desirable points.

Berkshire.—Large for age; boar 2 years and over, not less than 450 pounds; sow, same age, 400 pounds; boar 18 months, 350 pounds; sow, same age, 325 pounds; boar 12 months, 300 pounds; sow, same age, 275 pounds; boar and sow 6 months, 150 pounds.

Duroc Jersey.—Large for age and condition; boars 2 years old and over should weigh 600 pounds; sow, same age and condition, 500 pounds; boars 18 months, 475 pounds; sow, 400 pounds; boars 12 months, 350 pounds; sow, 300 pounds; boar and sow pigs 6 months, 150 pounds. These figures are for animals in a fair show condition.

Chester White.—Large for age and condition; boars 2 years old and over, if in good flesh, should weigh not less than 500 pounds; sow, same age and condition, not less than 450 pounds; boars 18 months old, in good flesh, should weigh not less than 400 pounds; sows, 350 pounds; boars 12 months old, not less than 300 pounds; sows, 300 pounds; boars and sows 6 months old, not less than 150 pounds each; and other ages in proportion.

Victoria.—Boars 2 years old and over, when in good condition, should weigh not less than 500 pounds; sow, same age and condition, 450 pounds; boar 12 months old, not less than 300 pounds; sows in good flesh, 300 pounds; pigs 5 to 6 months old, 140 to 160 pounds.

Objections.

Poland China.—Overgrown, coarse, flabby, loose appearance; gangling, hard to fatten; too fine; undersize; short, stubby, inclined to chubby fatness; not a hardy, robust animal.

Berkshire.—Underweight, coarse, not in good form to fatten.

Duroc Jersey.—Rough and coarse and lacking in feeding qualities.

Chester White.—Overgrown, coarse, uncouth, hard to fatten.

ACTION AND STYLE.

Poland China.—Action vigorous, easy, and graceful; style attractive; high carriage; in males testicles should be prominent and of about the same size, yet not too large and pouchy.

Berkshire.—Action vigorous; style graceful and attractive.

Duroc Jersey.—Action vigorous and animated; style free and easy.

Chester White.—Action easy and graceful; style attractive; high carriage; in males testicles should be readily seen, same size and carriage.

Victoria.—Action easy and graceful, but quiet.

Objections.

Poland China.—Clumsy, slow, awkward movement; low carriage; waddling or twisting walk; a seemingly tired or lazy appearance; not standing erect and firm.

Berkshire.—Dull, sluggish, and clumsy.

Duroc Jersey.—Dull or stupid, awkward, and wabbling; in boars testicles not easily seen, nor of same size or carriage, too large, or only one showing.

Chester White.—Sluggish, awkward, low carriage, wabbling walk; in males testicles not easily seen, not of same size or carriage, or only one showing.

CONDITION.

Poland China.—Healthy, skin clear of scurf, scales, or sores; soft and mellow to the touch; flesh fine, evenly laid on and free from lumps and wrinkles; hair soft and lying close to body; good feeding qualities.

Berkshire.—Healthy, skin clear of scurf, scales, or sores; soft and mellow to the touch; flesh fine, evenly laid on and free from lumps; hair soft and lying close to body; good feeding qualities.

Duroc Jersey.—Healthy, skin free from any scurf, scales, sores, or mange; flesh evenly laid over the entire body and free from any lumps.

Chester White.—Healthy, skin clear and bright, free from scurf or sores; flesh fine and mellow to the touch, evenly laid on and free from lumps; good feeding qualities.

Victoria.—Healthy, skin clear and white or pink in color; free from scurf; flesh firm and easily laid on.

Objections.

Poland China.—Unhealthy, skin scaly, wrinkled, scabby, or harsh; flabbiness or lumpy flesh; too much fat for breeding; hair harsh, dry, and standing up from body; poor feeders; deafness, partial or total.

Berkshire.—Unhealthy, skin scaly, scabby, or harsh; flabbiness or lumpy flesh; too much fat for breeding; hair harsh, dry, and standing up from body; poor feeders; deafness, partial or total.

Duroc Jersey.—Unhealthy, scurfy, scaly, sores, mange; too fat for breeding purposes; hair harsh and standing up; poor feeders.

Chester White.—Unhealthy, skin scaly, scabby, or harsh; flesh lumpy or flabby; hair harsh, dry, and standing up from body; poor feeders; total deafness.

DISPOSITION.

Poland China.—Lively, easily handled, and seemingly kind and responsive to good treatment.

Berkshire.—Quiet, gentle, and easy to handle.

Duroc Jersey.—Very quiet and gentle; easily handled or driven.

Chester White.—Quiet, gentle, and easily handled, with ambition enough to look out for themselves if neglected.

Victoria.—Quiet and gentle.

Objections.

Poland China.—Cross, sluggish, restless, wild, or of a vicious turn.

Berkshire.—Cross, restless, vicious, and wild.

Duroc Jersey.—Wild, vicious, or stubborn.

Chester White.—Cross, restless, vicious, or wild; no ambition.

DISQUALIFICATIONS.

FORM.

Berkshire.—Very large and heavy or drooping ears; small, cramped chest-crease back of shoulders and over the back so as to cause a depression in back easily noticed; deformed or crooked legs; feet broken down, so that the animal walks on pastern joints.

Duroc Jersey.—Ears standing erect; small, cramped chest; crease back of shoulders and over back, so as to cause a depression in the back easily noticed; seriously deformed legs; badly broken-down feet.

Chester White.—Upright ears; small, cramped chest; crease around back of shoulders and over the back, causing depression easily noticed; feet broken down, causing the animal to walk on joints; deformed or badly crooked legs.

Victoria.—Crooked jaws or deformed face; crooked or deformed legs; large, coarse, drooping ears.

SIZE.

Berkshire.—Overgrown, gangling, narrow, contracted, or not two-thirds large enough for age.

Duroc Jersey.—Very small or not two-thirds large enough, as given by the standard.

Chester White.—Chuffy, or not two-thirds large enough for age.

CONDITION.

Berkshire.—Barrenness, deformed, seriously diseased, total blindness from any cause.

Chester White.—Squabby fat, deformed, seriously diseased, barrenness, total blindness.

Victoria.—Excessive fatness, barrenness, deformity in any part of the body.

SCORE.

Berkshire.—Less than 60 points.
Duroc Jersey.—Less than 50 points.
Chester White.—Less than 60 points.

PEDIGREE.

Berkshire.—Not eligible to record.
Duroc Jersey.—Not eligible to record.
Chester White.—Not eligible to record.
Victoria.—Not eligible to record.

COLOR.

Chester White.—Black or sandy spots in hair.

Victoria.—Other than white or creamy white, with occasional dark spots in skin.

Differences between breeds as units.—The foregoing remarks apply to the individual characteristics of the animals of the different breeds, regarding them simply from the meat-producing standpoint. Considering each breed as a unit, it will be noticed that there are varying degrees of adaptability to environment. One breed succeeds well in a certain locality while another does not; some breeds graze and "rustle" better than others. In the Northern States color is only an incidental item except in the case of purebred stock, where a color standard is always maintained; but in the Southern States white hogs are not desired, it being claimed that they are too susceptible to the heat of the sun.

SELECTION OF A BREED.

The principal point to be observed in the selection of a breed is, therefore, its adaptability to the climate and environment of the locality in which the beginner desires to operate. The best plan will be, obviously, to make a selection from the breeds already established in the neighborhood, consulting successful breeders freely. If, as sometimes happens, a man finds himself compelled by circumstances to become a pioneer in hog raising, a selection should be made from breeds already successful in sections of the country similar to his own. Broadly speaking, there is no "best breed." All have their strong points. Most of them will flourish in almost every part of the country; but consulting his own personal preferences and the locality in which he lives the farmer will find that, for his own use, there is probably a

breed that he may consider the best. When a breed is once chosen it should be reasonably adhered to, and promiscuous crossing with other breeds avoided.

THE BREEDER.

After the locality and breed have been decided upon, and the various details that are incident to a beginning settled, it may be well for the beginner to examine into his own qualifications. To make stock raising of any kind a success a man must be, first of all, a lover of animals, taking a delight in their growth and development and quick to understand their needs. He must enjoy the labor of caring for them and must be willing to give that labor without grudging and often without stint. He should be cleanly and neat in habits, and then his barnyard will be likewise. A knowledge of some of the laws of sanitation and veterinary science will be a great help, and an acquaintance with the principles of selection and breeding of stock is, of course, a necessity. The apparent ease with which many men succeed with live stock is due, in large measure, to the possession of this intimate knowledge of the habits and requirements of their animals. They do not pamper their stock, but they never neglect it. The personality of the breeder, including good health, natural intelligence, etc., has more to do with success or failure than any other factor after a suitable location, and will do wonders toward overcoming a harsh climate and an unproductive soil.

THE FOUNDATION HERD.

The first selection of breeding stock is of prime importance. The effects of mismating are always difficult to breed out of a herd, and the effect on a beginner is such that a mistake may completely discourage him. It is good economy to make haste slowly at this time. The start should be made with a few animals; five sows will make a large enough herd for the first year. They should be good individuals, and it will even be much better to buy one high-class sow than five poor ones. This will be real economy and the development of the herd will prove its value. It will be well if a beginner can obtain the assistance of an old and successful breeder in making a start.

SELECTING THE SOWS.

The expression "the male is half the herd" is repeatedly quoted. So far as our knowledge of heredity has developed, other conditions being equal, there is uniform prepotency in both sexes; the influence of the two parents on the offspring is theoretically equal. Therefore, if the boar is half the herd, the sows certainly make up the other half, and their selection is a highly important matter. They may be purchased, already bred, some time before the boar, and quite an item of expense will thus be saved. Then by the time the sows have been

watched and studied for a season and have each raised a litter of pigs, the owner will be much better prepared to select a suitable male, and he can then get one to use on both dams and offspring.

The sows selected should be nearly the same age, which should be about twelve months, and all should be safe in pig, preferably to the same boar. Their individual characteristics should, perhaps, be first looked to. While hogs do not show the strong differences of sex that we look for in a cow or a mare, these always constitute a marked feature of a good brood sow. The smoother forehead and lighter, finer neck are points of distinction from the signs of masculinity in a boar. The forehead should be broad between the eyes, the throat clean and trim, the neck moderately thin, and the shoulders smooth and deep; the back should be fairly wide and straight, and ample room for the vital organs should be provided by a good width and depth of chest, well-sprung ribs, and straight, deep sides—a deep, capacious body from end to end. Depth of chest and abdomen are specially important in a brood sow. Pinched chests and waists must be avoided. It is generally advised that sows with much length of body should be selected for breeding purposes, length of body being regarded as an indication of fecundity. It will certainly do no harm to select sows that are especially long, but care should be taken that quality go with the increase in length. The loose-jointed, long-coupled, slow-maturing, and slow-fattening type should not be allowed to get a foothold in the herd. The influence of length of body on a sow's fecundity is by no means positively known. Many very short-bodied sows have proved to be wonderfully prolific breeders. The surest means by which to select prolific sows is to keep an accurate record of the herd and cull all sows that do not yield a certain percentage annually. Each sow should have at least twelve well-developed teats, thus providing for the proper nourishment of large litters.

The important qualifications of the market hog should be looked for; viz, smoothly covered shoulders, a wide, straight, deeply fleshed back, well-sprung ribs, straight, deep sides, broad rumps, and deep, well-rounded hams. A broad, well-developed pelvic cavity will generally insure a sow easy in parturition. The body should stand on moderately short, straight legs, with a moderate amount of bone. All hogs, particularly breeding animals, should stand well up on the toes. There is a tendency, more marked in some breeds than in others, for the pasterns to break down, so that the animal walks on the pastern bone instead of on the toes. This is particularly the case of the hind pasterns and is oftener noticed in boars than in sows. It is a weakness that seriously impairs the usefulness of the animal.

Brood sows should, of course, show quality, but this should not become overrefined and delicate. Extremes of refinement usually lead to delicacy of constitution and often accompany sterility.

As a last but very important point, these first sows should be uniform in type. Uniformity of type goes far beneath the surface. It includes every part of the internal organization. The reproductive system, the digestive system, the circulatory system, and even the nervous system influence uniformity. The breeder may often be disappointed in his results from sows that he thought were of a uniform type. His pigs are a heterogeneous lot, unpleasing to the eye, unsatisfactory in the feed lot, and profitless to the pocket. In such a case a lack of uniformity in the powers of heredity may no doubt be assigned as the cause of these unfortunate results. It must be borne in mind that it is comparatively easy to select sows that are uniform in quality, constitution, and conformation. This may be done by any skillful judge of hogs. But our only basis for the selection of animals uniform in reproductive powers and heredity of type is the breeding record of their sires and dams and the standard of the herds from which they come. For this reason it is readily apparent why it is an advantage for the beginner to select his sows from one well-established herd. Whether the sows will be uniform in breeding powers can only be determined definitely by testing them in the herd, but to select them from the same herd or from herds of similar breeding will be a reasonable guaranty of good results. When a sow has shown herself to be a prolific breeder she should be retained as long as her reproductive powers are maintained.

Uniformity in a herd is the surest index to the worth of the stock and the skill of the breeder, and its advantages are obvious. A uniform lot of pigs will feed better, look better when fattened, and command a higher price on the market than a mixed lot. With a bunch of sows closely conforming to the same standard, whose reproductive powers are similar, uniform pigs may be expected.

The importance of the male in the herd should not be asserted at the expense of the females, yet the importance of a male of marked excellence must not be minimized. The boar represents 50 per cent of the reproductive power concentrated in one animal; the sows represent an equal amount of reproductive force, divided up among ten or twenty or fifty individuals. If, then, these females do not, in their conformation and fecundity, conform strictly to the same type, they are merely convenient machines for the birth and rearing of young—not what they might be, an influential force in furthering the plans of the breeder and raising the standard of the herd. It is not proposed to discuss at length in these pages the operation of the forces of prepotency as varying factors in breeding operations. The relative influence of one parent over another, the swamping of a weakly organized female influence by a strongly prepotent male factor, or vice versa, are interesting and important, but belong to the special study of heredity.

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SELECTING THE BOAR.

If there is a tendency at times to exalt unduly the influence of the boar and neglect that of the sows, the beginner should not permit himself to reverse things and entirely neglect the boar. It was, indeed, the feeling that any male could be used so long as he had sufficient strength for service that brought about arguments in favor of the value of the boar. A breeder can not afford to neglect the animals of either sex. The male has, perhaps, the greater influence on the herd, for the simple reason that every pig in the herd is sired by him, whereas they have not all the same dam. To achieve the best results, a breeder should never allow the standard of his sows to be lowered, and should always couple them with a boar of a little better grade. One thing must not be forgotten, and it indicates the chief difference between the influence of the two sexes in the herd. A superior boar may be used on a herd of inferior sows with good results, but the use of an inferior boar on sows of high quality will have a disastrous outcome. The one method raises the standard of the herd; the other inevitably lowers it.

A boar with the male characteristics strongly developed should be selected, preferably as a yearling or else as a pig that had been purchased at the same time as the sows and allowed to come to maturity before using. He should have a strongly masculine head and a well-crested neck. His shoulders should be developed according to age: but strong shoulder development in pigs under a year or eighteen months is objectionable. The same indications of a good pork-producing carcass that the sows required should be seen in the boar—a broad, straight, deeply fleshed back, much depth and length of side, and well-developed hind quarters. The boar should be selected to correct any defects that may be common to the sows; for example, if the sows are rather coarse in bone and loosely built, the boar should have high quality—fine bone, skin, and hair. If the sows tend toward overrefinement and delicacy, the boar should be rather rangey and strong-boned. There is a common belief that the male parent influences principally the extremities and general appearance of the offspring, while the vital organs (the heart, lungs, and viscera) resemble those of the female parent. This theory is strongly questioned by some modern authorities on heredity; but so long as our knowledge of the subject is so limited and this particular phase is in dispute, it can do no harm to select breeding animals according to the old ideas. The visible organs of the reproductive system should be well developed and clearly defined. A boar should not be bought with small, indefinitely placed testicles. Avoid particularly a boar with only one testicle visible.

The boar should stand up on his toes. There should not be the slightest indication of weakness in the pasterns of a young one; in a

mature boar (2 or 3 years of age) that has seen hard service it may be expected that he will be a little down on his pasterns, but a 6 or 8 months old pig that does not carry himself on upright pasterns is not a safe animal to select for a herd boar; the hind pastern will be in much danger of breaking down with a little age and service. Look carefully to the set of the hind legs. The back should be carefully set, straight, and closely coupled to hindquarters. A crooked or long-coupled back is as great a drawback as a weak pastern.

FEED AND MANAGEMENT.

The details of selection, feed, and management of live stock are intricately interwoven and interdependent. A man may be an excellent judge of stock, able to select those animals for his herd whose use will give the best results in breeding; but if his system of feeding and management is not such that the animals will thrive and yield a good increase, good selecting is rendered ineffective. On the other hand, the herd may be carefully fed and skillfully managed, the feed may be the best and properly combined, the shelter warm and dry, and the water supply pure; but if the herd is poorly selected the owner is practically throwing away the feed he gives them.

THE SOWS.

Hogs require attention, regardless of condition, age, or sex, but the management of the brood sows is the surest test of the breeder's skill. If sows are carelessly fed during pregnancy, trouble of some kind is sure to ensue at farrowing; if overfed after farrowing, losses may occur among the pigs from scours and thumps. At no time is the development of the pigs so easily influenced as while they are dependent on the sow's milk—the first month of life. Excepting the ravages of epidemics, perhaps the greatest death losses in the herd occur during this time, including farrowing. The accidents during farrowing, an attack of scours due to the milk of the dam, or a chill while following the sow in pasture on a wet day, may stop growth temporarily, leaving a permanently stunted pig, or may result fatally. On the other hand, the results of good management during pregnancy are as marked as the unfortunate consequences of careless methods.

MANAGEMENT DURING PREGNANCY.

It is assumed that bred sows are purchased as the foundation stock. If these sows are not all from the same herd, they should not be placed together until they are all known to be free from vermin and contagious disease. They must be washed or dipped and quarantined from each other at least thirty days. If they come from the same herd, quarantine may not be necessary.

It is always well for a purchaser to ascertain from the seller the details of management and feeding to which the animals were accustomed before changing owners. This system of feeding should be conformed to; or, if this is not possible, the old ration should be gradually replaced by the more convenient one, the time of transition being from ten days to two weeks. For the first few days newcomers should be fed lightly.

During pregnancy two facts must be borne in mind. The first is that the sow is doing double duty. Not only is she keeping up her own bodily functions, but the development of the fetal litter is a constantly increasing drain on her system. Although feeding at this time will not need to be so heavy as after the pigs are farrowed, it should be liberal. The sow's condition should be "good"—neither too fat nor too lean. An error which would allow the sow to become fat would perhaps be least productive of serious consequences. It is hardly too much to say that the mistakes in feeding breeding animals are more frequently those that keep such stock in a thin, half-starved condition, under the idea that the reproductive organs are so peculiarly liable to become transformed into masses of fat that the least appearance of fat on the animal's back and ribs will be the first step in bringing about such unfortunate circumstances. The use of the reproductive organs in either sex creates demands of an unusual nature on the animal organism, and these demands must be met in the same manner as those of a different character—such as growth, work, etc.; and that is by providing liberal supplies of the proper kinds of feed. It is beyond reason that a sow can give birth to a strong litter of pigs after having gone through a four months' fast. The importance of ample feeding of pregnant females, in the case of sheep, has been shown recently by Mumford[a] in Missouri. He found that during the first six to nine weeks of life those lambs having the heaviest birth weight made the greatest gains; the records of the gains of the lambs after weaning were not tabulated. As the development of the fetus is intimately associated with the nutrition of the dam, it is urged that "we can profitably pay more attention to the development of the unborn lamb." Whether a similar fact may be true in the case of hogs is yet to be shown. It may not be unwise to assume that it may be so. Bad results undoubtedly may be brought about by overfeeding, especially as sows are naturally indolent and loath to exercise; but a counteracting influence will be found in ample exercise that may be provided by a large pasture, or even by driving slowly a mile or two each day. The necessity of exercise must not under any circumstances be overlooked.

It must be remembered, in the second place, that the main demands upon the sow are those for the building of new tissue. Hence the

[a] Bul. No. 53, Missouri Expt. Sta.

kind of feed is important. What are known as the nitrogenous, or protein-bearing, feeds are needed at this time. These are bran, oil meal, pease, beans, oats, and barley, and, to a moderate extent, wheat. The forage plants that are especially suitable to pregnant brood sows are the clovers and their relatives—alfalfa, peas, beans, vetches, etc. The ordinary pasture grasses are also of much value. Feed should be given in such form that the system of the sow will be at its best. All breeders lay special emphasis on the condition of the bowels during pregnancy, and particularly at farrowing, the special danger to be avoided being constipation. To this end, the greater part, if not all, of the grain ration is given as slop; and, toward the close of the period of gestation, oil meal, or a small amount of flaxseed meal, is introduced into the ration.

Corn should not be fed in large amounts to breeding stock. If possible, it should not be fed at all to any but fattening animals. In the corn belt many farmers are often so situated that they have no other grain feed at hand. If corn must make up the greater part of the ration of the brood sow, the injurious effects may be counteracted in a measure by compelling the sows to exercise. Various schemes may be necessary to bring about this result, such as having the house and feeding floor or the feeding floor and watering place at opposite ends of the hog lot; so that a good walk is a necessity several times each day. If the lot is located on a hillside, the walk is made a climb. Some men scatter grain among straw and corn fodder with this idea of exercise in mind, and others resort to the whip and drive the sows gently for a mile or two each day.

During the winter more care will be needed to keep the sow in good health on account of the absence of pasture. Not only does the hog's system crave green feed, but more or less bulk is demanded. This is especially needed when a considerable amount of confinement is necessary. To offset the lack of green feed, nothing surpasses roots. These may be sliced or pulped and mixed with the grain or may be given whole, as a noon feed. Some care must be used in feeding roots, as they are laxative in effect, and if fed in excessive amounts, may bring about profuse action of the bowels. Some Eastern farmers recommend the use of silage. If neither is available, clover or alfalfa hay, sheaf oats, or corn fodder may supply the bulky requirement of the ration with good results. Charcoal, ashes, and salt should be accessible at all times. These act as a vermifuge and preventive of disease and meet the hog's craving for mineral matter in the feed. The constant use of such a preparation with a varied ration, will, in large measure, prevent sows from eating their pigs at farrowing time. During the entire period care should be taken to keep the system well toned. The condition of the bowels is highly important; for pregnant and "down" pigging sows are subject to constipation, which may have serious results during farrowing. The sow should become

accustomed to being handled, and should look upon her attendant as a friend.

All the brood sows may run together up to within two weeks of farrowing time; then it is well to separate them, placing each sow by herself in a yard with a small house, such as has been described, which should be dry, airy, and clean. A great deal of exercise will not now be necessary. The feed should be reduced somewhat, and, if there is any tendency to constipation, a slight change of feed may be necessary. If individual houses are not available sows can not be separated until near farrowing time.

The farrowing pen should be provided with fenders around at least three sides about 6 or 8 inches from the floor and 6 or 8 inches from the wall. These should be strong enough to support the weight of the sow should she lie on them. They will, in a large measure, protect the pigs from being lain upon during the first few days of their lives. This will go far to prevent a very fruitful cause of loss among young pigs. The little fellows will soon learn to creep under these fenders when the sow lies down.

Many breeders now use a specially arranged farrowing pen for sows, the object being to allow the sow room enough to farrow with reasonable comfort, but not enough to turn around. The safety of the pigs under such circumstances is said to be much greater than when the sow is given all the space she cares to take. Provision is made for the safety of the pigs by raising the walls of the pen 6 or 8 inches from the floor. Such a pen may be readily arranged by placing the sow at one end of her pen and nailing boards across so that she can not turn, leaving space for the pigs to slip under the barrier. A number of patented farrowing pens are on the market.

OPINIONS OF BREEDERS.

In the preparation of this bulletin, requests for methods and experience in hog raising were sent to successful breeders in different parts of the country. These men were practically all breeders of pure-bred hogs, and it may be objected at first thought that methods used by them are too expensive to warrant their application to the production of hogs for the market. To a certain extent this is true. A man with 50 or 100 sows will hardly find it possible or economical to keep an exact breeding record of each one; he can, however, keep himself acquainted with the breeding record of the herd by grouping those sows that are due to farrow at or near the same time and those that farrow or raise litters of certain numbers. Constitution, uniformity, disposition, etc., can all be regulated in a market herd in the same manner. In feed and management, however, the methods of the successful breeder of purebred animals may be taken as models. Because a pig is a grade is no reason why he should be compelled to live in filth, eat poor feed, and sleep where fortune compels him, often

without a semblance of shelter. There is, of course, a possibility that attention may be so assiduous that the animals suffer; but, where one hog is killed by care and kindness, thousands die from disease which gets its foothold on account of insanitary surroundings and improper feed. With this idea in view, the opinions of breeders on various phases of the industry are given. These opinions are the personal experiences of men in the business and represent various ideas and theories. It is therefore obvious that the Bureau of Animal Industry is not responsible for any statements made therein.

The following replies were among those given in response to the question, "What system of feed and management do you pursue to prepare sows for farrowing?"

George Aitken, Woodstock, Vt.—In the summer they are put into a separate inclosure with a temporary shelter; in the winter they are in separate pens and fed laxative feed—principally mangels.

H. O. Mathews, Concord, N. H.—I keep my brood sows in a moderate condition—not too fat; feed on hotel waste combined with mixed feed, sugar beets, and clover hay; give them exercise in yards all winter, and warm, dry beds, making sure that they have pure air.

E. W. Davis, Torringford, Conn.—The one thing needful is to have the bowels loose. I have had excellent success in feeding mangolds through the winter. These, with wheat bran, will bring the best of hogs. Sows should also have exercise; then, with the above feed, there is no danger of them destroying their pigs.

Theron E. Platt, Newtown, Conn.—For feed we use skim milk and wheat feed, with some green feed, such as roots and cabbage for winter and in summer grass or clover.

Richard H. Stone, Trumansburg, N. Y.—The sows are well cared for and well fed; feed warm bean soup with wheat bran or middlings, with some bone meal and tankage. To 150 head we feed about 400 gallons of soup per day.

Edward van Alstyne, Kinderhook, N. Y.—I keep my sows in good condition, not fat nor very thin, giving them laxative feed, and pasture if possible. In the winter they have silage or roots with wheat bran and plenty of exercise in the open air, on the ground if possible.

F. H. Gates & Sons, Chittenango, N. Y.—We feed middlings mixed with hominy meal or clear middlings in whey or skim milk; this will keep their bowels loose and the animals in good growing condition (not fat). We give a dry bed of straw, just a thin layer on the floor, and arranged so that the little pigs can not get into the gutter.

George L. Gillingham, Moorestown, N. J.—They are allowed the free run of the pasture the entire year, with warm, dry houses to sleep in, not over three or four being put together, to avoid crowding. The feed in summer is wheat middlings, apples, or other refuse fruit, and pasture; in the winter they have rye to graze when the snow is off, with roots, clover hay, middlings, etc., but very little corn.

William M. Dickson, Woodside, Del.—We give as large a lot to range as possible. The feed in winter is silage, turnips, and slop with bran and meal in it. This is varied with a little corn on the ear; never cob meal.

J. S. Burns, Clinton, Pa.—By breeding time in the fall the sows are usually rather thin in flesh, especially if they have raised a fall litter. For two or three

weeks before we mate them we feed some corn in connection with clover pasture; but if there is no pasture we use corn, milk, and mill feed, making a ration with a ratio of about 1:7 or 1:8, depending on the sow's condition. If she is in good flesh we do not begin so soon and the ration is made narrower. The object is to have the sow vigorous at breeding time. We continue the feeding in this way until they are in such flesh as most people would think fat enough for pork, then narrow the ration to about 1:4 or 1:5, dropping out the corn about four weeks before farrowing; if in midwinter, furnishing warm quarters instead of heat-producing feed, avoiding everything that would produce a feverish system. We feed turnips, beets, parsnips, etc., for succulence. We always allow exercise, giving the range of a pasture lot. The feeding place is some distance from the sleeping quarters.

N. S. Burrier, New Midway, Md.—After a sow weans her pigs I breed her at once, as she is generally thin in flesh. I feed her all she will eat of such feeds as bran and middlings, pasture, etc., and any feed, except corn. Feed only two ears of corn twice a day to each sow, but try to put on flesh with other feeds, giving the sow plenty of range. An apple orchard is a splendid place for this; if a spring branch runs through it, so much the better. By this method of feeding the sow is in good flesh by farrowing time and the pigs are large and strong; whereas, if the sow is shut up in a close pen and fed on corn, the pigs will be small and weak. Some people always say that my sows are too fat at farrowing time; but I find that theirs are too poor; one can hardly ever get a sow too fat on the right kind of feed and plenty of range.

John F. Lewis, Lynnwood, Va.—I generally feed shorts and bran made into a mash once a day and a feed of corn once, if the weather is very cold; if not, I feed shorts, bran, and barley, equally divided as to bulk.

Thomas S. White, Lexington, Va.—I have eight farrowing pens of two rooms each. I watch my gestation table and put the sows (one in each two-room house) a few days before farrowing, each sow then having a sleeping room and dining room; the former can be made perfectly close, the latter is open overhead. I feed bran mashes with a little corn for a week before farrowing.

J. C. Graves, Barboursville, Va.—I allow the pregnant sow plenty of range for exercise and feed mainly on bran, mill feed, and oats in winter, with some corn. In grazing time corn is all that is needed to supplement pasture.

Charles A. Kuhlmann, Hamilton, Va.—When nearing farrowing time I still allow my sows a grass range, if possible, or a lot in which to exercise themselves. Only a few are allowed to run together. I also furnish them with a good dry house, into which they can go at their own free will. I slacken the feeding until no corn at all is fed, and feed a mixture by weight of bran 3 parts, shorts or middlings 3 parts, corn meal 3 parts, old-process linseed meal 1 part, all in the form of slop.

W. K. Pickens, Livingston, Ala.—I feed wheat shorts made into slop and give the sow plenty of exercise, pure water, a warm sleeping place, and keep her free from all excitement.

W. E. Davis & Bro., Sherman, Tex.—When the sow is bred we put her on a pasture of some sort—oats, wheat, or alfalfa, as the case may be—and feed her on dry corn at night and soaked corn in the morning. We try to keep her gaining flesh all the time from breeding time to farrowing.

H. E. Singleton, McKinney, Tex.—From the weaning of one litter to the next farrowing sows have the run of a pasture and are fed bran and corn, the amount to be determined by the quality of the pasture.

Clifton Chisholm, Roswell, N. Mex.—My sows during the summer, when there is no green alfalfa, get nothing but alfalfa hay fed in racks for four months before farrowing. Out of 500 sows which farrowed this summer I had to assist only one.[a]

Mark Butterton, Miller, Okla.—My system of managing the sows before farrowing is to give them plenty of range on green pasture, with plenty of oats and a little corn. This year (1902) I have fed ground wheat with the best of results. In all cases I am careful not to let the sows get too fat.

A. D. Outher, Homestead, Okla.—My sows are given lots of range and an abundance of green wheat, alfalfa, cowpeas, and rape, besides oats, barley, wheat, corn, and shorts. They have exercise, sunlight, and roomy pens.

H. P. Wilson, Gadsden, Tenn.—For spring farrow I usually breed in November or December and give the sows the run of the fields and woods, with winter oats, rye, and rape for green pasturage, until growth stops from the cold, then I give bran and middlings mixed into a fairly thin slop twice a day with a little shelled corn, giving the corn after the slop. In midwinter I give the sows such hay as I have—clover, millet, cut corn, pea vine, or sorghum. I usually warm water for them in very cold weather. They have comfortable small houses to sleep in, two or three sows being in each house until near the farrowing period, when I give each sow a separate house. I feed all the salt and ashes they want and occasionally give them a round of prepared stock food. Keep lice from them by coal oil and grease or some of the disinfectant dips, which are also used freely in and around the sleeping quarters.

Karl B. Clough, North Amherst, Ohio.—During the warm months the sow has a large range on clover and blue grass with plenty of good water and shade. Should this not give enough food to keep her putting on flesh, a thin slop of middlings twice a day is added. As she becomes heavier with pig the middlings are increased, with the end in view that the sow will be in good condition at time of farrowing. In the cold months she is fed cowpeas, soja beans, or clover hay that has been baled. To this is added a slop of middlings or barley and a little corn meal. During early spring winter rye is pastured and takes the place of hay. We aim to keep the sow increasing in weight from the time of service until she farrows. Wood ashes, salt, and sulphur should be before them at all times. A little bone meal in the slop is very good.

Aaron Jones, jr., South Bend, Ind.—We give our sows as much outdoor exercise as possible; in fact, we never aim to have hogs in inclosed pens at any time. We think hogs grow faster and are more healthy if kept on pasture, and never on the same pasture and feed lots to exceed two years. Sows get little corn; good rich slop made from bran, middlings, finely ground rye, and ground wheat constitute their feed; blue grass and rape, their pasture. We aim to keep them tame and gentle, so that they can be handled at all times, and when farrowing time comes we have no difficulty with our sows; but should any of them have any trouble or fail to raise a good, large, thrifty litter we immediately discontinue her use as one of our brood sows and put her at once in the feed lot for market.

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[a] It is interesting to note that during December, 1902, Mr. Chisholm shipped to South St. Joseph, Mo., a train of nine loads of high-grade Poland China hogs that had been fattened on alfalfa and Kafir corn. Three loads, averaging 272 pounds, topped the market at $6.47½, selling considerably higher than the tops of the Kansas City and South Omaha markets for the same day. The remaining six loads averaged 223 pounds and sold at $6.37½. The train was run through from Roswell, N. Mex., to South St. Joseph, in forty hours without loss. It was the first shipment ever made from New Mexico to that market.

T. B. Pearson, Thorntown, Ind.—I desire a diversity of feed, consisting of shorts, oil meal, ground oats, with plenty of grass or forage—such feeds as produce bone and muscle—avoiding corn for brood sows very much, as it produces fat, and fat is not desired in brood sows. In mating, I turn the sow to the boar and allow only one service, then remove the sow and keep her isolated from other hogs until she passes over the heat period, which will not usually last over two days after service.

Davis Bros., Dyer, Ind.—We give them a good pasture or lot that they may get plenty of range, and feed good wheat middlings made into slop, with little or no corn near farrowing time.

Thomas Bennett, Rossville, Ill.—I usually feed some corn and oats before farrowing; the sows run in blue-grass pasture all winter, and I try to make them walk a mile for breakfast, which makes 2 miles every morning. I feed sparingly. Fat brood sows are a curse to anyone.

A. G. Woodbury, Danville, Ill.—Give sows exercise. Keep in fair flesh. Not over one-third of the feed is corn, the balance being oats, shorts, bran, and roots, with clover hay or early cut corn fodder in the spring for spring farrow; for fall farrow keep on grass.

A. J. Lovejoy & Son, Roscoe, Ill.—We feed wheat middlings, ground oats, and pasture in summer; in winter, the same feed, except that we use sugar beets or sorghum for a succulent feed to take the place of pasture. We give plenty of exercise, and separate the sows a week before the time of farrowing.

J. D. Orn, Mount Pleasant, Iowa.—After breeding, the feed consists of corn and oats in equal parts, with plenty of range, and clover hay when they need it. About seven days before farrowing I give them their place for farrowing and a loosening feed.

C. S. Barclay, West Liberty, Iowa.—I give them plenty of exercise on pasture and feed corn lightly, giving a light feed made of wheat shorts or middlings mixed with oats into a thin slop.

O. S. West, Paullina, Iowa.—I feed bran, shorts, and oat siftings, a product of the oatmeal mills. Corn is of secondary importance for breeding stock. I also see that their bowels are in good condition.

W. L. Niles & Son, Ames, Iowa.—Breeding animals are kept separate from the herd and fed a mixed ration. The aim is to supply them with muscle-forming feed and guard against excessive fatness. Some little time before farrowing each sow is given a pen by herself.

W. A. Jones, Van Meter, Iowa.—From breeding until farrowing time I feed 2 parts oats, 1 part wheat (dry), for the morning feed; equal parts by weight of gluten feed, germ-oil meal, shorts, and bran made into a warm slop, for the noon feed, and corn on the cob for the evening feed. I give plenty of good pure water, preferring it warm in cold weather, and give access to salt, wood ashes, and charcoal. The sows should have plenty of exercise, and not too many should be put together. They should have a comfortable sleeping place and should not be disturbed. The sows should be put into the farrowing pens a week before farrowing and fed light feed, but very little if any corn. Use the grass pasture whenever you can.

William D. McTavish, Coggon, Iowa.—My brood sows are fed twice daily. The morning feed consists of one-half wheat middlings and one-half ground oats, with a little oil meal added and thoroughly mixed; for drink, pure water. The evening meal is about five ears of corn to each sow, and pure water. Clover hay is fed every morning.

William B. Lambing, West Liberty, Iowa.—Three weeks before farrowing I feed oats chop once a day, corn once a day, and 1 pint of old-process oil meal once a day.

N. M. Shaffer, Cascade, Iowa.—Sows should have a slop made of mill feed, either bran, shorts, or ground oats, with some oil meal and a little ear corn. I think much of a good pasture. In the first place, a man should not keep too many hogs in one place, and small shoats should not be kept with a lot of old hogs, as they are apt to get crippled or smothered. In breeding hogs a man can not have too many lots, so as to change them often. He should clean the lots often. It is better to plow them and sow some grain; it makes good pasture. I have not lost a sow in farrowing in over ten years.

F. F. Failor, Newton, Iowa.—My sows have a blue-grass pasture of 40 acres in the winter and about 160 acres in the summer, and are fed a mixed ration of ground corn (including cob), with whole oats.

M. H. Donelson, Ogden, Iowa.—This time of the year (spring) the feed is one-third corn, one-third oats, and one-third shorts all ground, mixed, and fed as a rather thick slop. We grind the oats and corn with a seven-horse power gasoline engine, and buy the wheat products. Feed some corn at night when the weather is cold.

Thomas Teal & Son, Utica, Iowa.—We feed very little corn at any time to our brood sows while carrying their young. We make it a point to have them gaining in flesh at the time of breeding, and feed on oats, wheat, rye, and a small amount of ground corn.

R. J. Johnston, Humboldt, Iowa.—Oats and bran. I do not believe in feeding breeding stock much corn; wheat is far better. Corn is all right to finish with.

L. L. Young, Oakland, Nebr.—All my hogs are grown mainly on tame pastures and fed but little grain. For brood sows I select only the best developed, of a feminine type, and strong constitution. From breeding time to farrowing they are fed about equal parts of oats, wheat, and shelled corn, night and morning, and are fed sorghum cane or clover hay at noon; this causes them to take exercise. They are also fed a mixture of salt, ashes, air-slaked lime, and soft coal. Occasionally I give them a little lime in their drinking water, to supply bone-making material for the fetus. Sows are allowed to take exercise up to within two days of farrowing.

C. H. Searle, Edgar, Nebr.—We feed the same as the stock hogs until about two weeks before farrowing, when we put them in a good, warm house and feed slops made of one-third bran and two-thirds shorts, and feed beets twice a week, but no patent stock food.

E. F. Jackson, Malcolm, Nebr.—We feed sparingly of grain, allowing them a run of grass, with plenty of fresh water, shade, and comfortable sleeping quarters. We raise purebred pigs for the trade and want March and April farrow. Our aim is to have the sows in healthy, vigorous condition at breeding time. When the sows are safe in pig, they are divided into small lots of from three to six each. The feed is increased a little as the weather becomes colder, but they are not allowed to get fat and sluggish. We often let them out together in a large field in daytime and put them back in their separate quarters at night. They enjoy the run of the field, hunting about for something they do not have in the lot. Our hogs are fed only at morning and night, and we have come to think it more profitable to use the feeds that can be grown on the farm. The corn is fed shelled to the brood sows in farrow, scattered thinly along the ground, compelling them to eat slowly. We grind corn, oats, and wheat together in equal

parts, and this, with the milk we get and the grass, makes a capital feed for the brood sow and suckling pigs.

S. McKelvie & Son, Fairfield, Nebr.—It is difficult to say here, but sows should have room to exercise at will and should not be too fat at breeding time. After breeding, large numbers should not be kept together, and they should not be fed too liberally on corn or other concentrated feed. It is well if they can have the run of a pasture. Bran and alfalfa are good things to balance their ration.

A. T. Shattuck & Son, Prosser, Nebr.—We feed little corn; all the other grains are good except rye. The sows have alfalfa hay in winter. They have plenty of exercise, good dry sleeping quarters well bedded. Rye straw makes the best bedding.

Charles E. Sutton, Russell, Kans.—My sows are fed principally on mill feed—shorts, middlings, and bran—with practically no corn, and are allowed a large pasture, sowed to rye, rape, or sorghum. About three weeks before farrowing, they are put in separate yards, 20 by 40 feet each, with a 7 by 7 foot house with a board floor and a safety rail 8 inches from the floor.

C. A. Stannard, Emporia, Kans.—I give them the run of a pasture and feed enough to keep them in good, strong condition (not too fat)—a mixed feed made into slop about as thick as porridge. I mix 1 ton of feed as follows: 600 pounds wheat shorts or low-grade flour, 600 pounds ground oats, 200 pounds oil meal, 600 pounds corn chop; mix with water.

J. P. Davis, Fairview, Kans.—At breeding time we separate the brood sows from the others and feed at least one feed of slop, made mostly of bran—two-thirds, and one-third shorts or corn meal. In cold weather this is cooked and fed warm; in warm weather it is soaked for about twelve hours before feeding.

Theo. Louis, Louisville, Wis.—As a rule, we feed 2 parts of shorts to 1 of corn; steam cut clover, mix the above grain with it and feed warm. We feed more or less roots. We separate the old and young sows at feeding time and feed once a day.

George Wylie, Morrisonville, Wis.—During the entire period of gestation our sows are fed on a ration consisting of oats, shorts, and corn in about equal parts, each fed separately; the oats are fed unground and are spread thinly on a tight floor. There are two or three meals or more of roots each week, the amount increasing as farrowing time approaches.

G. W. Plank, Laird, Minn.—I feed a variety of feed, such as corn, oats, and shorts, with a small portion of flaxseed meal, made into a thin slop, with such kitchen slops as are at hand. There is plenty of room for exercise.

Lewis Pond, Churchs Ferry, N. Dak.—I feed bulky feed, such as ground oats, mangel-wurzels, carrots, etc., and am careful not to feed too much greasy kitchen swill, as it will make sows too fat. I see that the sows always have a dry, clean bed. Plenty of exercise is the tonic for health.

G. E. Dyksterhuis, Granada, Colo.—In winter I feed one-half pound ground wheat and one-fourth pound of oats and corn each, ground and mixed into a thick swill, morning and night. I feed sugar beets at noon and as much fourth-cutting alfalfa hay as they will eat clean, with an abundance of fresh water. I give them plenty of exercise and see that their bowels are in good condition. To prepare sows for farrowing (and to keep hogs in condition at any other time), I give them free access to a box of corncob or wood charcoal, mixed with salt and sulphur and sprinkled with a solution of copperas.

James Bolinger, Brush, Colo.—For March pigs I prefer to let the sows have 160 acres or unlimited range, with first-cutting alfalfa cut before blooming, or third cutting, to run to, and give stock barley or corn enough in the evening to keep them thriving. For September pigs my sows have the run of a good alfalfa pasture, with one-half to three-fourths pound of corn soaked and fed at night, so that they will eat it and lie down; otherwise, the green alfalfa seems to carry the corn out undigested.

Stone Brothers, Manhattan, Mont.—We give plenty of exercise by letting them run in a large pasture and giving enough slop and grain in addition to keep them in fair condition.

William Stufft, Kalispell, Mont.—I feed screenings from the elevator, bran and shorts equal parts (dry), with plenty of clear water handy, feeding twice a day. The sows run in pasture and sleep in an open shed on the ground.

G. W. Cooper, Moscow, Idaho.—I give slop and carrots or roots of any kind and plenty of good green pasture, never feeding wheat or corn to sows before farrowing time, as they are more apt to eat their pigs as a consequence of such feeding.

Hazelwood Company, Spokane, Wash.—We give a small grain feed daily, with a feed of roots and beardless barley in the sheaf. Sows are allowed a full run and get plenty of exercise.

John Redmond, McMinnville, Oreg.—I let my breeding sows run on clover pasture or wheat stubble fields, with a feed of chopped oats (two-thirds) and chopped wheat (one-third), night and morning, and plenty of running water.

S. B. Wright, Santa Rosa, Cal.—Young sows that are intended for breeders are fed liberally on grain where they can and will take plenty of exercise; they get green feed or squash, pumpkins, or apples until served and safe in pig. They are usually 8 months old when bred, and weigh 250 pounds or more and have large frames. After this they seldom get any grain until after farrowing, but have good pasture of grass, clover, or whatever I can provide conveniently in the nature of green feed.

Sessions & Co., Los Angeles, Cal.—We have little or no pasture, but intend to keep sows supplied with fresh-cut alfalfa and pumpkins, beets and citrons (stock melons) in their season. We feed skim milk when we have it, and a portion of shorts or ground wheat.

M. H. McCord, Bakersfield, Cal.—I feed sows a liberal mixed ration of shorts and ground oats, which produces a strong, thrifty pig. I keep sows in a thrifty condition, not fat. As this is an alfalfa country, I have had good results from sows which were not fed anything but what they ate in pasture.

Thomas Waite, Perkins, Cal.—When grass is plentiful they run on grass and make their own living on pasture. I find the refuse of fruit a good thing for hogs.

FARROWING TIME.

Sows vary little in the period of gestation. This period is about 112 days from the date of breeding. This date should be known, to avoid mistakes that may result in loss of pigs. As the time for farrowing approaches the sow should be watched carefully, in order that assistance may be given if necessary. If she has already farrowed a litter, and has been properly fed and cared for during pregnancy, little difficulty may be expected. With young sows, par-

ticularly those bred at an immature age, there is a considerable element of risk at this time, not only to the pigs but to the sow herself.

The bedding of a sow at farrowing time should be sufficient only for cleanliness and dryness. If furnished in large amount the pigs will burrow into it and get lost or be crushed. The best bedding is rye straw and wheat straw, and if the straw is cut it makes an almost ideal bed. Chaff is excellent if it can be obtained. Oat straw is not so valuable.

The management of sows during farrowing will depend largely on the animal and on the weather conditions. Assistance should be at hand if needed, but the sow should not be helped if she is getting along nicely alone. Many pigs are lost annually by lack of attention during farrowing; but, on the other hand, there is no doubt that in many cases overanxiety and too much attention may do more harm than good and often result seriously. The assistance that is imperative at this time is to help in cases of difficult labor and to protect pigs from chilling in cold weather. The temperament of the sow should be considered; some are plainly annoyed by the presence of an attendant and show it in their nervous actions; others may be positively ill natured and resent interference. Such sows are better left alone during farrowing, and should be bred to farrow when warm weather may be expected; so that the chances are as much in favor of the pigs as possible. If the sow's nervousness or ill nature leads her to eat her pigs, the best remedy is to put her in the pork barrel at the earliest opportunity.

When farrowing occurs during warm weather, a minimum amount of attention will be needed. The pigs are less likely to become chilled at this season and will generally find their way to the teats unaided. Proper preliminary feeding of the sow and good quarters will make the chance of trouble small. On the other hand, if a sow farrows during extremely cold weather the pigs will be in danger of being chilled unless the house is heated. To remedy this some breeders throw a blanket over the sow until she is through. Others place a few hot bricks or a soapstone in the bottom of a basket or barrel, covering them with straw, and put a cloth over the top to prevent too rapid radiation; and, unless the sow objects too seriously, the pigs are placed in this receptacle as fast as they arrive. They will not suffer if they do not suck for a few minutes, and they will be dry and warm when placed to the teats. This treatment will be necessary even in warm weather with sows that are nervous and move about during farrowing. When farrowing is over the pigs should all be placed to the teats, care being taken that each one gets his share. When the afterbirth is passed it should be removed at once and burned or buried. There is good reason to believe that the eating of the afterbirth is often the beginning of the habit of eating the pigs that is so troublesome with some sows.

In very cold weather it may be necessary for a few days to remove

the pigs to a warm place after they have sucked, to prevent chilling. As new-born pigs suckle as often as every two hours during the day, this entails considerable inconvenience; but it is time well spent and may mean the difference between profit and loss to the breeder. The pigs are soon able to fight their battles with the cold unaided by any but their own warmth and that of the dam.

For the first twenty-four hours the sow should, as a rule, have no food, and will need none. If, however, she shows signs of hunger, a thin slop of bran and shorts or a thin oatmeal gruel may be given. Tepid water should be given to drink as the sow wants it. Never give cold water.

The feeding for the first three or four days should be light and carefully given, and the time consumed in getting the sow on full feed should be from a week to ten days, depending on the size and thrift of the litter. The first feed should be very light, and in the form of a thin, warm slop, such as is mentioned in the preceding paragraph, working gradually to full feed. The pen should be cleaned daily if the sow is confined to it.

OPINIONS OF BREEDERS.

The following were among the replies to the question "What is your management of sows at farrowing?"

George Aitken, Billings Farm, Woodstock, Vt.—In summer all brood sows run to pasture where there is abundance of shade and water; in the winter they are kept in pens with a concrete floor covered with cut-straw litter; have yards for exercise, with a stream of water running over the concrete; are fed very little grain, the feed being principally dairy swill and plenty of beets fed raw.

Smith Harding, Westfield, Mass.—They should be kept by themselves for a few days to get accustomed to their new home. I feed rather light feed a day or two before farrowing and nothing but water for the day after. I also feed rather lightly until the appetite is fully restored, then add milk, if I have it, with middlings, ground oats, and other light feeds.

A. M. Lyman, Montague, Mass.—The sows are divided off into breeding pens about two weeks before farrowing. These pens are 6 by 8 feet, with a railing around the inside 10 inches from the bottom, so that the sow can not lie on the pigs. I bed with shavings.

Richard H. Stone, Trumansburg, N. Y.—I put them in warm pens about 8 by 8 feet, with a fender around the side about 8 inches from the floor; have an attendant with them at farrowing, and always keep a lantern lit at night and hanging in the pen; then the sow will not lie on the pigs.

Edw. Van Alstyne, Kinderhook, N. Y.—The sows have a quiet place by themselves, to which they have been accustomed for at least a week. Not too much of fine, dry bedding. The niches of the pen are protected by planks so that the sow can not lie close to the niche and so lie on the pigs. No feed of any kind is given for at least twenty-four hours after farrowing—just a little warm drink; then light, warm feed in small quantities, until the pigs begin to demand the milk. If constipated, the sow is given one-quarter of a pound of Epsom salts. If the above system is observed, this will not often be necessary.

D. J. Warbasse, Newton, N. J.—Seven to ten days before due shut the sow by herself and give a good bed of straw, so that the pen will be well lined before farrowing. Feed a little corn, with bran and middlings and some roots. At farrowing leave her alone, unless something is radically wrong, and feed lightly for a few days. Do not disturb a sow for say twelve hours.

F. W. Lewis, Chaddsford, Pa.—If the sow is careful, I do not disturb her or feed for twelve and sometimes twenty-four hours; with sows that are not to be trusted, I remove the pigs at once and keep them away until farrowing is over; then let them nurse and put them to the sow every two hours until four days old, when longer periods elapse.

J. S. Burns, Clinton, Pa.—As long as convenient before farrowing each sow has a separate pen and lot (we use portable pens). Never confine her until she begins to make bed to farrow. Everything is made clean and the sow closed in the pen. We treat her in such a way that we can go in the pen and stay with her if need be. No feed of any kind is given for twenty-four hours, then a drink of milk diluted with water. We then begin feeding, lightly at first, and feed for the first four weeks about the same as the four weeks before farrowing. If farrowing comes in April pasture will be at hand and corn may be added, making the ration about 1:6½. When the pigs begin to eat, provide a trough by themselves and feed them skim milk at first, then add oil meal and mill feed.

R. L. Munce, Canonsburg, Pa.—I have them in pens by themselves at least one week before farrowing; put in chaff for bed (not much); put a guard rail around the pens to keep the sows away from the wall and give the pigs a chance to get under; feed lightly at first, increasing the feed as the pigs get older, feeding a slop made of equal parts of bran and shorts (by measure) with one-tenth part (by weight) of oil meal.

John Snowden, Bowie, Md.—My sows are put in warm, sheltered pens, 8 by 16 feet, 8 by 8 feet of which are plank floors, the remainder dirt, about ten days previous to farrowing. They are supplied with leaves and fine straw for bedding, but not too much.

Chas. A. Kuhlmann, Hamilton, Va.—Two or three days before farrowing I put each sow in a pen by herself. The pen is about 8 by 16 feet, divided into two parts, and the sow is allowed to have free access to both. The house has shelves or boards nailed around on the inside from 10 to 12 inches from the floor, projecting about 5 or 6 inches from the walls, thus making an escape for the pigs should the sow get the pigs between her and the house and lie down. I give a liberal amount of wheat straw for bedding and keep a close watch. When I think the sow is about ready to farrow I close her up in the house and arrange to be with her at farrowing. Sometimes she becomes very restless, and in her misery may get up and down very often and hurt her pigs, but when she begins to get restless if rubbed on the breast she will usually lie quietly. As soon as the little fellows are born I break off the navel cords about 2 inches from the body; do not cut. This prevents navel rupture and often saves the life of a pig, as the sow may lie on the long cord and then overlie the pig. After the sow is through farrowing and the afterbirth is thrown away, I leave her. I feed her very lightly for about three days and then begin increasing the feed until she is on full feed again, which is in about ten days. I give the sow her first few feeds in the house, but begin feeding in the pen as soon as conditions are favorable. Clean out the house about three days after farrowing, and see that the sow and pigs have a good, dry bed.

Sam T. Smith, Troy, Ala.—If the weather is rainy and cold I make them a good nest in a stable and put them in there two or three days before due, but if

the weather is good I let them choose their own places in the woods or straw fields. In either case I stay with them until they get through, and always keep a close watch on them for two or three days, hardly ever losing a pig.

W. E. Davis & Bro., Sherman, Tex.—About two weeks before farrowing we put the sow in a pen by herself. In this pen is a good warm house, with straw for a bed. We feed the sow on the kind of feed we want her to have after farrowing, which is corn and shorts slop, both night and morning. Be on hand at the time of farrow to see that all goes well and see that each pig has sucked before we leave. We give the sow nothing to eat for the first twenty-four hours, only water; then give a thin slop and some alfalfa hay to fill up on. We are careful not to feed too much, as this is the most critical time in the pig's life, and if the sow is overfed it causes too large a flow of milk, and this causes scours in the little ones and is often death to them. We have been raising purebred hogs for several years and find that if we can get them two weeks old, we can raise nearly all of them.

M. C. Abrams, Manor, Tex.—Ten days before farrowing I fasten each sow in a pen by herself, about 10 by 20 feet, one-half of which is shedded. Feed a light swill diet until four or five days after farrowing, then increase the feed so as to give the full amount by the time the pigs are 10 or 12 days old. The feed is wheat bran and corn meal for slop—oats and corn for grain.

Clifton Chisholm, Roswell, N. Mex.—As near to farrowing time as possible I put my sows in separate pens which have running water in a trough and are half closed and half open, and feed them a very little slop made of shorts. After farrowing the feed is increased and a little Kafir corn added. About two weeks after farrowing I remove sow and pigs to alfalfa pasture.

H. P. Wilson, Gadsden, Tenn.—I try to get their systems in tiptop shape by farrowing time; they then need very little help through that period. I have never owned a sow that needed any aid, although I always try to be near at hand. After the pigs are dry and suckle I water the sow, and in twelve to eighteen hours give her a good feed of thin slop; in ten days I have the sow and pigs on green pasture.

J. S. Henderson, Kenton, Tenn.—About two or three weeks before farrowing each sow is given a lot to herself, with a comfortable house to sleep in. At farrowing time I watch them very closely until I see that the pigs are sucking all right. I do not get my sows on full feed until the pigs are a week or ten days old, and then feed as before farrowing.

Geo. W. Dozer, Roseville, Ohio.—I feed nothing for the first two days except water with the chill off, after which I add a little wheat bran and increase the rations of bran, middlings, and crushed oats, made into slop and fed in troughs, as much as will be eaten with avidity without dulling the appetite.

N. P. Kershner, Ansonia, Ohio.—One to two weeks before farrowing each sow is placed in a small yard with a farrowing hut, and is watched closely to give assistance if needed. During the first twenty-four hours nothing is given but a drink of water with the chill off; then bran is given in milk or water, at first 1 quart at a feed, increasing to 1 gallon at a feed, twice daily, about a week after farrowing, when a little middlings may be added to the bran. The pigs are watched closely, and if any signs of scours appear the middlings are removed a little longer and then added slowly. At three weeks I can commence to feed one ear of corn twice a day, if the sow has a large litter, increasing as the pigs can stand it. At about five weeks the pigs will begin to look for something to eat, which should be provided where the sow can not molest them. It is a little milk

at first, then a little wheat middlings in the milk, then a little shelled corn for them to crack, keeping up the milk and middlings and increasing the feed as they are able to bear it, but never overfeeding.

F. P. & J. J. Hardin, Lima, Ohio.—About two weeks before farrowing we remove them from the herd to a small lot containing a farrowing house, with a floor in the east end and a large window on the south. The roof is so constructed that we can raise part of the south side to let in the sunshine; we also get the morning sun through the door, and consider sunshine the most essential feature for spring pigs. We feed the sow very lightly for a week or ten days after farrowing, then increasing to full feed.

M. L. Bowersox, Bradford, Ohio.—When the little fellows begin to come I am present with the sow, and as fast as they come place them in a box. When all have come I place them to the sow and help them to suck, putting them back in the box when they have satisfied their appetites, and letting them take a nap. While the little fellows are away from the sow, so that the operation does not disturb her, I break their little teeth with small nippers, so that when they are suckling they will not bite the sow's teats and disturb her; care must be exercised in this that little pieces of the sharp teeth do not go down the throats of the pigs. I then put them to her and make it my business to look after them for a few days; when I hear the sow giving suck, I go and assist the pigs, especially if the litter is large, and by this method I have had sows raise litters of fourteen pigs and all to do well, but they must be helped in the start.

Aaron Jones, jr., South Bend, Ind.—About one week before farrowing each sow is put in a small pen and kept there for one week after, when I turn her and the litter out on grass and let them run together until the sow ceases to look after the pigs, and they wean themselves by natural methods.

Jacob Polley, Union City, Ind.—Most sows will do better at farrowing with no one present. Most persons are too anxious about the sow's welfare and do more harm than good. I have watched many of my sows farrow, and the most good I have done was to see that the coating was removed from the pig's nose so that it could start breathing. If a sow is able to farrow that is the most she needs. A few times when the sow had difficulty I have had to pull the pigs, and in such case the hands are the best instruments I ever saw, as they are not dangerous.

T. B. Pearson, Thorntown, Ind.—One week previous to farrowing time place each sow in good, comfortable quarters, so that she may get accustomed to the same by the time she is due. Handle her often, get her gentle, and feed a slop made of shorts and ground oats, but little corn. Give her a good bed, but not so much that she will pile it up and overlie the pigs. Do not disturb her to feed for eighteen hours after farrowing; let her remain quiet. Feed warm bran slop sparingly for one or two days, as there is great danger at this period of producing too much milk flow and giving the pigs scours.

James D. Kiger, Charlestown, Ind.—After the sows farrow we give no feed of any kind for twenty-four hours, but give all the water the sow will drink, as she is very feverish at this time. From then on we give ground feed made into a slop, the same as before the sow farrowed, a mixture of equal parts of hominy meal and ground oats, or a mixture of 2 parts bran and 1 of shorts, the slop being made thick enough to pour. Feed lightly for the first ten days, to prevent scours in the pigs from too much rich feed. When we are certain that there will be no trouble from this cause we put the sow on a full ration and feed some corn. With this treatment the pigs can be weaned at eight weeks old, when they are ready to go on rye or clover pasture.

Thomas Bennett, Rossville, Ill.—Put them in a single house with plenty of bedding. The quieter they keep the better. If they do not move for a day or two after farrowing so much the better. I have known them to lie in their beds for three days without any feed or water. Feed a little thin shorts slop, as little as possible, so as to keep the sow quiet.

A. J. Lovejoy & Son, Roscoe, Ill.—Give no feed for twenty-four hours, but give them what water they will drink, then commence to feed gradually and increase as the pigs are able to take all the milk the sow gives. After a week give the sow all she can eat of milk-producing feed.

H. M. & W. P. Sisson, Galesburg, Ill.—A few days before farrowing the sows should be put in separate pens, so arranged that they can be turned out every day for exercise. They should be fed moderately on feed that will not constipate them. After the sow has farrowed she should not be fed for perhaps two days, but should be supplied with plenty of water. If inclined to be constipated, a light bran mash fed a few times works very successfully. She should be fed moderately for a few days, gradually increasing the amount up to full feed. She should still have opportunity for daily exercise. When the pigs are about three weeks old they should be fed in an adjoining pen, where the sow can not interfere with them. The sow and pigs should have access to a good pasture as soon as there is grass.

J. D. Orn, Mount Pleasant, Iowa.—Have them in good, dry quarters, watch them closely, and if cold I put a blanket over the sow and pigs until the sow is through pigging. The sow is given a good feed before she commences to farrow.

W. L. Niles & Son, Ames, Iowa.—Each sow is provided with good, dry, comfortable quarters, fed nothing but water for a day after farrowing, and then put on feed gradually, when she is fed all she will eat of corn and sloppy feed largely made up of wheat shorts. In season all sows have the run of pasture.

W. A. Jones, Vanmeter, Iowa.—The sow is put into the farrowing pen a week before farrowing and fed light feed, but very little, if any, corn. The farrowing pen should be dry and clean, with a moderate amount of bedding, which should be changed often. The pen should be arranged to let in the sun when there is any. If the sow is restless and careless, stay with her and take the little fellows away from her and put them into a barrel that has been prepared with some nice dry straw and two or three hot bricks under the straw; cover the barrel, leaving an air hole. When the sow is through her trouble, get nicely acquainted with her and quietly put the little ones with her. If they nurse all right and the sow is quiet and comfortable, go away and let nature do the rest. Do not give the sow anything to eat; give warm water—dishwater is best. On the second day, mix a little bran and shorts with water; the third day the same. Watch carefully whether your sow is a heavy suckler and feed accordingly.

W. M. Lambing, West Liberty, Iowa.—I put each sow in an individual house, to which is attached a small lot. The house is 7 by 8 feet, with fenders around the sides. I try to be with the sow when she farrows, and keep her in the house until the pigs are four weeks old.

F. F. Failor, Newton, Iowa.—Sows are kept in separate pens, as near the ground and as free from drafts as possible. They are fed very lightly from the day of farrow for a few days, with a gradual increase of feed as the pigs grow older. The pigs have plenty of exercise and sunlight, and, above all, a dry and clean bed.

M. H. Donelson, Ogden, Iowa.—I have a house standing north and south, with pens 8 feet square on either side of an alley 4 feet wide. The pens have fenders or pockets around the sides to keep the sow from hurting the pigs. As soon as they get old enough I have them on grass. They must have exercise.

Thomas Teal & Son, Utica, Iowa.—We feed nothing for forty-eight hours, except some weak slop of some kind, putting in a small amount of oil meal, increasing a little every day, with a feed composed of oats, wheat, rye, oil meal, and a small amount of ground corn, fed in slop.

L. L. Young, Oakland, Nebr.—Give nothing but water for the first two days; feed lightly for the first week, then increase to not quite full feed. The sow is kept in a farrowing pen and the pigs allowed to go out and in at will for two weeks, then the sow is turned out for exercise about one hour a day, at which time the pigs are kept in. At this time the sows have access to some green pasture. I do not like to have sows or young pigs out on pasture in cold, rainy time.

C. H. Searle, Edgar, Nebr.—We have them in a good warm pen with a good bed. If the weather is cold we have a stove in the farrowing pen with which we keep the room good and warm. We stay with the sow when farrowing.

J. V. Wolfe, Lincoln, Nebr.—If quiet, attend the sow and remove the pigs to a corner or other place of safety with as little noise as possible until the sow is through. If cold, dry them with a cloth and hand rub them. Clean up the litter, give dry bedding, return the pigs, and assist them to their first dinner.

A. T. Shattuck, Prosser, Nebr.—Put sow in farrowing pen 8 by 8 feet, with fenders around the pen. Be there to take care of the pigs if necessary. Feed lightly for the first few days. Right here is where you must mix in brains.

T. J. Congdon, Pawnee City, Nebr.—About a week before farrowing I shut each sow up by herself so that she will get used to her quarters. I give them plenty of good, clean straw. I know that this is contrary to the ideas of professional breeders, but my experience has been that if you give a sow a good lot of bedding she will pile up her nest and crawl into it, get herself out of sight if possible, and very rarely ever get up or come out until she is through farrowing. They will often lie twelve to sixteen hours without stirring. I always place water where they can get it when they first come out. When you give only a small amount of bedding they are apt to keep getting up and down and often kill their pigs. I give nothing to eat for the first twenty-four hours, then give a little thin slop, increasing gradually until you get her on full feed, which will take from ten days to two weeks, as the pigs begin to draw on the mother. I give them the best and richest feed I can get for them. (Don't change their feed unless you do it very gradually.) I know that this is contrary to the opinions of most breeders. They claim it will give the pigs the scours, but if you will commence slopping the sows before farrowing, and are careful about changing feed and give them a dry, warm place to sleep and keep them out of the damp cold and wet, I will risk the scours. More pigs have scours from having a wet place to sleep than from any other one thing.

S. W. Schooley, Cozad, Nebr.—Put the sows in separate pens a week before the time to farrow. Have the pen about 7 feet square, with fenders around the sides, then when the time for farrowing comes be on hand and look after the little fellows. Put them in a box, keep them warm, and they will soon dry. When the sow is through farrowing put them with her, rubbing her, and see that the pigs get a good dinner.

R. C. Marshall, Arlington, Nebr.—I have the date of breeding and know just when they will farrow. I shut them up two or three days before farrowing. After they farrow, I feed no grain or slops for twenty-four to forty-eight hours, then feed lightly, and get them on full feed in five to eight days. Try to have the sow gentle and quiet and be with her at farrowing. Remove the pigs as fast as farrowed until all arrive, then put each to a teat and see that all nurse and get filled up. Allow very little bedding. Give the sow a warm slop with

just enough bran (say 1 quart) for the first twenty-four hours to sweeten the water, then increase gradually.

H. W. Cheney, North Topeka, Kans.—Have box stalls 8 by 12 feet for each sow. Unless the sow is very large she gets little attention. In the case of big sows, we remove the pigs to a box and keep them there several days, allowing them a chance to suck five or six times a day.

Newton Bros., Whiting, Kans.—Put in clean farrowing pen and keep them quiet. Be on hand to attend to it in person. Never get mad and use them roughly. Never assist unless absolutely necessary, then use judgment and care. Get pigs to nursing, and then clip tusks. Give the sow plenty of pure water but no grain for twenty-four hours. Use common sense and favor nature in every detail possible.

John D. Marshall, Walton, Kans.—Shut her in a warm pen two or three days before farrowing time, giving only a little bedding. Have your sow perfectly quiet, so that you can work with her and the pigs without exciting her. Clean out all the bedding the second day after farrowing, sprinkle the pens well with air-slaked lime, and change the bedding every two or three days.

M. H. Alberty, Cherokee, Kans.—Put sows in a tight 8 by 10 house with fenders: feed nothing for twenty-four hours after farrowing, but give small quantities of lukewarm water often. The second day after farrowing feed lightly on the same kind of feed that the sow was used to before farrowing, and let her out to exercise every day.

L. L. Frost, Mirabile, Mo.—I use a single pen, affording dry, warm quarters. In cold weather I stay with the sow until the pigs have sucked once. Do not feed the sow for twenty-four hours and do not give her all she will eat until the pigs are ten days old.

Evan Davies, Keytesville, Mo.—I have them farrow in 8 by 8 foot pens, using a guard rail fastened 12 inches from the wall and 8 inches high. I use very little bedding until the pigs are a week old, cleaning the pens out daily, using air-slaked lime on the ground before putting fresh bedding down. At farrowing time I feed shorts slop mixed with clear water.

F. M. Lail, Marshall, Mo.—A few days before the sow is due to farrow, I shut her in a small lot attached to the farrowing house and reduce her feed, using only ship stuff and bran, equal parts by weight, mixed with water. Have the bowels loose, and there will be no trouble at farrowing nor danger of the sow eating her pigs. After farrowing, I give nothing but water for twenty-four hours and a very light feed of the swill named for two or three days more; then I gradually increase the feed until the sow is on full feed in a week.

W. O. Wilson, Okemos, Mich.—If the weather is cold, stay right with her and see that the pigs do not chill, but get dry and have something to eat. Give the sow nothing but drink for the first twenty-four hours, and feed sparingly for a week or two, according to the number of pigs in the litter. Increase the feed with the increase of the demands of the pigs on the sow.

W. H. Lessiter, Pontiac, Mich.—I always try to have my sows very tame, so that I can be right in the house with them when they farrow. I use individual hog houses, 6 by 8 feet, with a fender around the inside. If the sow is uneasy when farrowing, I put a board across the house about 2 feet from the back end and resting on the fender; this makes a first-class farrowing pen.

D. S. & F. Smith, Belleville, Wis.—We have a few little houses, 5 by 7 feet, which we consider fine; put the sow in a few days before her time; feed mostly

on slop up to farrowing, then lightly until the pigs begin to draw on the dam, then increase to all she will eat up clean. We feed fine middlings or flour, middlings and bran, or ground barley and oats, each one-half, for slop.

George Wylie, Morrisonville, Wis.—We put them in safety pens that they can not turn around in, thus preventing them from overlying their pigs; as a rule we keep from them and do not offer them anything to eat until they get up and look for it, then give them a drink of thin slop.

F. E. Rutter, Ferryville, Wis.—For the first twenty-four hours I feed only a little bran, say, 1 pint in a gallon of water twice a day; then increase the amount of bran and give oats gradually, getting them on a full feed of bran mash by the time the pigs are a week to two weeks old, according to the size of the sow and the number of pigs, giving all the oats they will eat after their meal of bran mash.

Theodore Louis, Louisville, Wis.—I keep a record of each sow when bred and feed her two weeks before farrowing in her pen alone on the same food that she has been fed up to the time to farrow.

Thomas H. Canfield, Lakepark, Minn.—Keep the sows quiet; have a man in attendance in case of help being needed; in cold weather take away the pigs and keep them warm until all are farrowed; care depends greatly on the temperament of the sow.

C. H. Murphy, Caledonia, Minn.—I prefer to have the sow running around the barnyard or in the pasture until about her time to farrow; sows farrow more easily when they have had plenty of exercise. I put the little ones in a box until the sow is through farrowing, then I bring them back a couple of times to feed before they are left entirely.

O. R. Aney, Wilmot, S. Dak.—The sow is fed on a thin slop composed of shorts and bran from the time of mating to farrowing time. Just before farrowing she receives a liberal feed of oil cake or about a gill of raw linseed oil; this produces an easy farrow. I never feed anything for the first twenty-four hours, but give the sow a drink of water. If she is fed at this time it will cause too large a flow of milk, and the little fellows will not be able to take it all; this will remain in the udder, causing milk fever, and it will also produce white scours in the pigs.

G. E. Dyksterhuis, Granada, Colo.—I place each sow by herself two weeks before farrowing and feed to keep her gaining just slowly up to two days before farrowing, then give her laxative feed and no grain for the next twenty-four hours, then increase the feed slowly. I am always on hand at farrowing and place the pigs to the teats right away, and stay there until the pigs can take care of themselves. I clean the beds twice a day. My farrowing pens are 6 by 8 or 8 by 10 feet, with fenders 6 inches wide placed 6 inches from the floor all around the pens. There is a window on the south side, air-tight, with ventilators to open if necessary. A yard is provided for each sow and litter in winter and pasture in summer. I feed my sows to a certain extent according to the size of the litters they have and the milking qualities they possess. While I never retain a poor milker, still some sows have rich milk while others give a larger amount of poorer quality. I study the characteristics of all my hogs, and breed for the best results as much as possible.

James Bolinger, Brush, Colo.—I have each sow shut up in a pen 8 feet square a few days before she is due to farrow, and try to be around at farrowing until she is entirely through; then I do not feed any for twenty-four hours. When passing I am careful not to disturb her.

William F. Stufft, Kalispell, Mont.—Shut the sow in hog house on floor in stalls 6 by 8 feet, with rails inside 6 inches from the walls and 8 to 12 inches from the floor. Bed with straw or hay; put in fresh bed every other day. Give sow plenty of water; feed sparingly for the first week on bran or oats.

G. W. Cooper, Moscow, Idaho.—I generally give them a good, dry place to themselves a week before the time is up to pig, and feed them swill and roots before farrowing. After farrowing, I feed bran and shorts mixed with the slop or fed wet with water. Keep the sow confined in the pen until the pigs are a month old, but have a hole for the pigs to run out and in for exercise.

Harry McQueen, Pomeroy, Wash.—I shut each sow by herself in a close pen with a good, warm shelter and plenty of dry straw for bedding, and feed them well. When they farrow, I never disturb them until they get up to eat; then give them all they will eat of a sloppy feed of ground grain soaked in water or house slops. Then they will likely be quiet until the next feed hour and are not apt to lie on the pigs or hurt them by getting up and stirring around.

John Redmond, McMinnville, Oreg.—I inclose sows in pens 8 by 10 feet with a 2-by-4 inch scantling around the pen, 8 inches from the floor and 8 inches from the wall, with cut straw or chaff for bedding. The sows are turned out in a lot daily for exercise; if they are watched closely, nearly all the pigs can be saved.

William Durrell, Gresham, Oreg.—When a sow shows signs of farrowing, I am on hand, and as my sows are quiet, I take the pigs as they are farrowed and place them in a box with hot bricks in the bottom, until they are all farrowed and dried off; then I let them all nurse at once.

S. B. Wright, Santa Rosa, Cal.—About one week before farrowing the sow is put into a pen 12 by 24 feet, with a box stall 8 by 12 feet attached. When she is due she is confined in the box stall, if it appears that she is about ready to farrow, and watched. Care is used so to feed that an excessive flow of milk will not be produced. Some pains are also taken to prevent constipation in the sow.

Fred Miller, Dospalos, Cal.—Sows are confined in pens about 8 by 16 feet, without bedding, and are not allowed anything but water for twenty-four hours after farrowing, after which the feed is increased gradually to the desired amount, which is about 2 pounds grain, barley, or wheat mixed with chopped alfalfa hay, and then soaked in skim milk or water. When possible, all the green alfalfa they will eat is added.

M. H. McCord, Bakersfield, Cal.—As a rule, I put the sows in separate pens a few days prior to farrowing, so as to become acquainted with their surroundings. I place a fine quality of hay in the pen, and let them make their own nests, as they know more about such things than I do; this done, they are quite at home. When the little ones come, if any of them are weak, I assist them to get their first feed, and after that everything is plain sailing. I never use violence with my hogs, especially with my brood sows, and I find that there is no domestic animal that responds so quickly to gentleness as the hog. I go among my hogs frequently, talk to them, and keep up a friendly acquaintance with them.

THE SOW A MOTHER.

No time should be lost after farrowing in getting the sow into the open air. Of course, if the pigs were farrowed during the winter months care will be needed, and it may be necessary to let the pigs reach the age of two weeks before turning them out. They can, however, get considerable exercise in the piggery or in the lot with the

sow, and there is often a lot adjoining a barn that is sunny and sheltered from cold winds where the new family may be turned for exercise. Avoid particularly allowing the pigs to run out during a cold rain. They are especially tender during the first weeks.

The appetite for something besides the dam's milk may begin to assert itself by the time the pigs reach three weeks of age. This time will vary, of course, some pigs being more precocious than others. They will be noticed nibbling at grass, rooting a little, and even investigating the sow's feed. A pen should be arranged adjoining that of the dam and separated from it by a partition with sufficient room at the bottom to allow the pigs to run under. In this inclosure put a low, shallow trough and place in it a little skim milk or a thin gruel similar to that recommended for the sow the first day after farrowing. This gruel may be made with any concentrate that is free from woody matter. If ground barley or oats is fed, the meal should be first sifted to remove the hulls. There is a great variety of feeding stuffs that can be used. The main point to be observed is that the pig's stomach is very easily deranged at this age and feeds must be given that will digest readily. The trough in which the pigs are fed should be kept clean. No stale feed should be allowed to remain in it from one feed to the next.

As the pigs learn to eat, the feed may be increased. Skim milk should be used liberally, using rather large quantities at first, from 6 to 12 pounds of milk to each pound of grain. During this period comparatively little corn should be fed, as a rule. More growth can be obtained with a narrow ration, and the corn should be withheld until the fattening period comes. The pigs should be kept growing constantly, and the best results will come with feeding a little under their capacity rather than all they can consume. To counteract the tendency to become too fat, they should have plenty of exercise.

Scours and thumps often cause very serious losses among young pigs. The former is caused usually by overfeeding, by feeding badly spoiled feed, by an abrupt change of feed, or by a change in the feed of the dam that affects her milk. Thumps is generally caused by overfeeding and lack of exercise.

WEANING.

If the pigs have been properly managed for the month after they first begin to eat, and are taking feed in amounts sufficient to make them more or less independent of the sow's milk, weaning will not be a difficult process and will be brought about so that it will be scarcely perceptible, so far as the effects on the pigs are concerned. The time to wean will depend on the way the pigs are eating and the convenience of the breeder. If they are not thoroughly accustomed to a grain and skim milk ration, the time must be delayed, and if there is no occasion for breeding the sow no harm is done by allowing the pigs to run with her to the age of twelve weeks or older.

Breeders differ widely as to the age of weaning. The majority wean at six to ten weeks, with a considerable number at twelve weeks; some older than twelve weeks, and a few younger than six weeks. The 398 breeders of purebred hogs, situated in all parts of the country, who stated definitely the ages at which they weaned their pigs, reported their practice as follows:

As early as 4 weeks of age	13
Not before 6 weeks of age	67
Not before 7 weeks of age	2
Not before 8 weeks of age	161
Not before 9 weeks of age	3
Not before 10 weeks of age	93
Not before 12 weeks of age	59

Those breeders who wean at the age of four weeks are generally in the States classified on page 249 as the East and New England. The breeders who wean at the early periods usually are situated where dairy by-products are plentiful and they usually raise two litters each year, making the demands of the pigs on the sow as brief and light as possible. Breeders in the corn belt wean at the more mature ages, rarely weaning as young as six weeks, and often allowing the pigs to reach the age of sixteen weeks before the sow is taken away. A considerable number of men make no attempt to wean, as the word is generally used—that is, there is no enforced separation of the sow from her pigs; the pigs run with the sow until her instinct tells her that they are old enough to shift for themselves.

The method of weaning will depend somewhat on circumstances. If the pigs are so little dependent on the sow's milk that she is gaining rapidly in flesh and lessening in milk flow, the weaning may be abrupt, the sow being taken away out of hearing. If she is still milking considerably she may be returned to the pigs once a day for two or three days, or the pigs may be taken away in detachments, beginning with two or three of the largest and strongest, then the next strongest, leaving the weakest ones of the litter to complete the drying off.

Whether the weaning is brought about directly or gradually, it should in all cases be complete and decisive. The pigs should be placed apart from the sows in quarters secure enough to prevent communication. By no means should pigs be allowed to follow a sow until she is almost worn out. The pigs are no better and the sow infinitely worse than if weaning had been brought about properly.

OPINIONS OF BREEDERS.

The following were among the replies to the question "At what age and how do you wean your pigs?"

Edward van Alstyne, Kinderhook, N. Y.—If the sow is to be bred shortly, I wean at six weeks; if not, I let them wean themselves. If weaned at six weeks, they should have begun to eat a little with the sow. They will suffer if they have

not done this. Feed small quantities of warm milk with a little middlings or oil meal in it three or four times a day.

E. R. Strawbridge, Moorestown, N. J.—Between six and eight weeks old. Fasten the mother in the pen and let the youngsters in once in a while if the udder cakes. Feed milk in a shallow trough to the little ones.

Tom Frazier, Morgan, Tex.—At two months, little weaning is necessary, as they are eating heavily of bran, oats, and corn. Then put the sows in close pens and leave the pigs where they were.

M. C. Abrams, Manor, Tex.—About eight weeks. When the pigs are from two to three weeks old I have a trough fixed on the outside of the farrowing pens; open a space large enough for them to come through, and feed milk, meal, and anything else that they like to eat. By the time they are seven weeks old they can do without their mother. I then commence decreasing her feed if I want to wean the pigs at this time, and in a week or ten days she will have weaned them. I always try to have an oat pasture for young pigs to go to.

Clifton Chisholm, Roswell, N. Mex.—My pigs have access to a slop of shorts and corn after they are one month old. I take their mothers away at two months.

J. K. Henderson, Kenton, Tenn.—I usually wean my pigs at twelve weeks old and sometimes at ten weeks old by beginning to feed some slops and milk (if I have the milk) at four weeks old, increasing the feed as they get older; by the time mentioned they wean themselves.

L. N. Jordan, Oakland, Ky.—From ten to twelve weeks. After they are four weeks old I feed them in a small trough by themselves, and at the age of ten to twelve weeks take them entirely from the sows.

O. P. McDowell, Plain City, Ohio.—At ten weeks. By that time the pigs are eating by themselves, and I shut the sow away or remove the sow to a distant pasture if possible, but never shut the pigs up. I place a trough where the sow can not get to it, and as soon as the pigs begin to eat, place a little warm milk in the trough and add a little shelled corn. As they get older I add middlings and finely ground oats; and as soon as the pigs are eating nicely I begin to decrease the slop given to the sow and give her more corn and less milk-producing feed. By the time of weaning, the pigs scarcely miss their mother and are not checked in growth.

N. P. Kershner, Ansonia, Ohio.—Ten to twelve weeks; sometimes eight or nine weeks, but ten or twelve is better; by increasing their feed and decreasing that of the sow, taking all her slop feed away from her and increasing her corn. This dries her up. I shut the sow up to dry off and let the pigs run.

Davis Brothers, Dyer, Ind.—With young sows that suckle down thin, we wean at five to six weeks; with others, at seven or eight weeks.

George G. Garretson, Matthews, Ind.—When the pigs are three weeks old, I prepare a pen that the pigs can crawl into but the sow can not. I place in this pen a very shallow trough in which I feed the pigs skimmed milk, being very careful to remove all that is not eaten before it becomes sour. As the pigs learn to eat, I add a little middlings to the milk; also give them some shelled corn. In this way they are fed all they will eat up clean until they are eight weeks old; then I remove the sow out of sight and hearing of the pigs.

W. W. Milner & Son, Thorntown, Ind.—Eight to ten weeks. Take them away from the sow all at once. Sometimes we return them to the sow in twelve or twenty-four hours to let them suck; then they are taken away for all time.

Thomas Bennett, Rossville, Ill.—I generally let the sow wean them, which they will do soon after being in farrow.

A. G. Woodbury, Danville, Ill.—Ten weeks. If not wanting to breed the sow for a fall litter, I do not wean pigs.

C. R. Doty, Charleston, Ill.—Wean at two and a half to three months—on a clover field if in summer and on steamed shorts or middlings if in winter.

William Walker, Pana, Ill.—In my opinion, weaning pigs is quite important. We wean in eight or nine weeks. As soon as the pigs begin to eat, which is quite soon after farrowing, we give them a little ground corn and ship feed, mixed with milk, in a pen by themselves. This pen is fixed so that they can go in and out at will without being disturbed by the sows. In this way they are hearty eaters at weaning time and can be weaned without trouble or backset. This plan also saves the sow, as the pigs do not worry her so much and she will keep in better flesh. She is removed from the pigs every other day when weaning them, so as to dry up gradually. This is done two or three times and the job is then complete.

J. D. Orn, Mount Pleasant, Iowa.—Let the sow wean them.

W. A. Jones, Vanmeter, Iowa.—I generally let the sows wean the pigs, which will be at about ten weeks old.

William D. McTavish, Coggon, Iowa.—I usually let the pigs wean themselves. They will do this if furnished plenty of feed out of reach of the sows.

M. H. Donelson, Ogden, Iowa.—Twelve weeks. Then never allow them to shrink; give the pigs all the milk you think best.

R. J. Johnston, Humboldt, Iowa.—Let the sow wean them.

B. L. Gosick, Fairfield, Iowa.—At ten weeks old I quit slopping the sows and they soon dry off and the pigs are weaned. Never shut the pigs up, and seldom have to shut the sow from the pigs.

S. McKelvie & Son, Fairfield, Nebr.—Teach the pigs to eat as soon as they will by placing tempting feed before them out of reach of the sow. They will then wean themselves at the proper time and never get a check in growth.

Chas. E. Sutton, Russell, Kans.—At eight to ten weeks. Have them all eating well at a separate trough. Take away all but the two smallest; a couple of days later remove one of these, and later the last one.

Evan Davies, Keytesville, Mo.—About twelve weeks, depending largely upon the growth of the pigs and the condition of the sow. I wean my pigs on cowpeas, milk, and a little corn.

Theo. Louis, Louisville, Wis.—We generally let the pigs wean themselves at one hundred to one hundred and twenty days.

A. H. Hendricks, Hazelgreen, Wis.—Ten to twelve weeks old. I shut up the sows; feed on dry oats and water. Let the pigs run at large and they will wean themselves in a few days.

O. R. Aney, Wilmot, S. Dak.—Spring litters at eight weeks and fall litters at ten.

G. E. Dyksterhuis, Granada, Colo.—I feed sows on dry feed from about the eighth or ninth week after farrowing (according to the thrift of the pigs) until they have gradually weaned the pigs in the most natural way without checking the growth of the pigs. I start to induce the pigs to eat at about the third week of age and increase their feed gradually. I avoid any check in the growth of the pigs as much as possible.

S. B. Wright, Santa Rosa, Cal.—Usually let the sows wean them, which generally occurs at eight to ten weeks old. The pigs eat well then and the sows are removed, the pigs remaining where they have been fed.

M. H. McCord, Bakersfield, Cal.—Anywhere between two and three months. I usually make an inclosure of panels to accommodate the number of pigs to be weaned and make an opening large enough for the pigs to get through. In the inclosure I place my troughs and begin feeding with shorts slop or cracked oats slop, and in a short time the pigs are well able to take care of themselves and never stop growing. When they begin to eat well I remove the mothers to another lot.

FEEDING THE PIGS.

Attention will now be given to the pigs that have been weaned. Up to this time all are on the same feed and under the same management. From now on, however, those that are to be retained as breeding animals should be continued on a growing ration—that is, one which is somewhat narrow and will develop bone and muscle to the largest extent; those that are to be fattened for market should be fed more liberally and their feed made more carbonaceous.

THE BREEDING STOCK.

The foundation on which to build up a successful breeding animal is ample range, affording an abundance of exercise, and a rather narrow ration. Growth should be continuous and feed plentiful. The pigs should not be given range so large and so little feed that they will develop nothing but bone; neither should they have so much to eat that they will become indolent and refuse to take the exercise required to develop necessary bone and muscle. Exercise will strengthen the sinews and develop strong muscles, as well as firm joints and strong legs, while a well-filled stomach will nourish these; and from this management we may expect a sow that will be strong, thrifty, and a good breeder, and a boar that will do good work in the herd without breaking down in any respect before he should.

Gilts should not be served before the age of 8 months, bringing the first litter at 12 months. This gives sufficient time for the development of the reproductive organs.

FATTENING.

As soon as it is determined what pigs are to be fed for market their fattening should be started without delay. Experiments have repeatedly proved that young animals always fatten more economically than old ones, and therefore any delay in finishing is accompanied with a loss. In rare instances it may pay to keep a pig over winter as a "store" hog; but generally he loses the flesh he accumulated while suckling his dam, and this can not be replaced except at increased expense. Corn will now come into the ration, and should be supplemented by all the variety of feed at the feeder's command,

to keep the appetite keen and the digestive system in the best condition. This variety should consist of mill feeds, dairy by-products, and succulent feeds, and, according to some authorities, pasture. If skim milk, whey, and buttermilk are at command they can be combined to very good advantage with the ration, commencing with a proportion of about 2 pounds of milk to 1 of grain at weaning time, and reducing the quantity of milk until the pigs are finished on grain alone. A pig gives best returns from dairy by-products while young. The fattening pigs should gain from 1 pound to 1½ pounds daily, and should weigh between 250 and 300 pounds at 9 or 10 months of age. Gains made after this weight are nearly twice as expensive as those made when weighing from 50 to 100 pounds, and a well-bred pig finished at a weight of about 250 pounds will very nearly fill the market requirements and bring a satisfactory price.

SELECTION OF BREEDING STOCK.

The pigs which are to be used for breeding purposes should be selected during the time when the pigs are with the sow. If he is raising hogs for market a breeder will select only sows, castrating all boars. No boar should be used or sold that is not eligible to registry. If the breeder is raising purebred stock the inferior boars will be culled out and castrated, the others being kept for the breeding market.

The selections should be made as early as possible, depending on the skill of the breeder. That noted feeder, the late Mr. William Watson, used to select his show lambs and calves not later than three days of age. He said an animal had all the development of heart and rib at that age that he would ever get, and his results in the show ring bear out the accuracy of his judgment. However, all are not endowed with the keen insight into animal form that Watson possessed. A selection for a breeding animal should not be made unless there are good and sufficient reasons for it, and unless the breeder is quite sure he is right in making the selection. The sows selected should be from large litters and from dams that are good milkers, and of quiet, motherly dispositions.

CASTRATING AND SPAYING.

The boar pigs should be castrated during cool weather, as soon as the testicles descend into the scrotum. An early date is always preferable to a late one; for the development of sex characteristics is of no value to an animal that is intended for meat.

The practice of spaying sows is not very general. It is much more difficult than castration. It often happens that sows which have been impregnated before spaying bear good litters of pigs after that operation.

The age of castration mentioned by correspondents has been tabu-

lated, and it is found that 341 breeders made definite statements, as follows:

At or over 1 week of age	5
At or over 2 weeks of age	40
At or over 3 weeks of age	1
At or over 4 weeks of age	57
At or over 6 weeks of age	66
At or over 8 weeks of age	64
At or over 9 weeks of age	2
At or over 10 weeks of age	26
At or over 12 weeks of age	80

MANAGEMENT OF THE DRY SOWS.

After the pigs are weaned the dry sows should be placed in a pasture by themselves and given very little grain. Those that show themselves to be prolific and good mothers should be retained as breeders; those having a deficient breeding record or being unsatisfactory in any way should be fattened and sold as soon as possible. It does not pay to keep over a year a sow that can not raise a large litter, unless she is purebred and a very exceptional individual.

If a second litter is wanted during a year the sows should be put to the boar during the first heat after weaning. Many breeders do not like to pass many periods of heat for fear that the sows may become "shy," and there is little reason why the sow should not have two litters a year. In any case, the sows should be carried on comparatively light feed until time to breed again, gaining a little in weight; and their treatment after breeding should be as already detailed (pp. 35–45).

MANAGEMENT OF THE BOAR.

The management of the boar has been left until this place in the discussion, not because it is an unimportant subject, but because the sows occupy by far the greatest amount of the breeder's attention; and also because it was assumed at the outset of this discussion that the work of a beginner, with only a group of brood sows, was being outlined.

When the boar arrives at the farm he should be dipped, as a matter of ordinary precaution, against the introduction of vermin. As an additional precaution, a quarantine pen should be ready for him, especially if epidemics are prevalent. In short, he should be treated in much the same manner as has been prescribed for the sows. His feed before change of owners should be known, and either adhered to or changed gradually to suit the new conditions. If he has come a long journey it will be well to feed lightly until he is well acclimated.

His permanent quarters should be a clean, dry, warm, well-lighted, and well-ventilated pen, 10 or 12 feet square, with a yard adjoining where sows may be brought for service. This yard should be large

enough to give him some exercise during the breeding season, when it may be inconvenient to allow him the run of a pasture. Adjoining the yard should be the boar's pasture, from one-half acre to an acre in extent, consisting of clover, alfalfa, or good pasture grasses that thrive in the locality.

Breeders generally advocate the practice of keeping a boar to himself during the entire year—out of sight and hearing of the sows. However, a boar is often allowed to run with the sows after they are safe in pig; but during the breeding season it is by far the best policy to keep him by himself, admitting a sow to his yard for mating, and allowing but one service. This will be productive of the best results in many ways. The energies of the male are not overtaxed. He may thus serve a much larger number of sows, and the litters will generally be larger and the pigs stronger. In the case of a sow that is a somewhat shy breeder and a valuable animal, she may be allowed to remain with a boar during the greater part of her heat; but such instances are exceptional. Another advantage of the single-service system is that a man always has an accurate knowledge of his breeding operations and knows when to expect farrowing time.

The feed of the boar when not in service may be of a succulent nature—mainly pasture and cut green forage during the summer months and roots in winter. A boar can hardly be sustained on this alone, and some grain should be allowed to keep him in condition. This should be nitrogenous in character, consisting of mill feeds—such as shorts, middlings, and bran—some oil meal, and the leguminous grains, with a little corn. As the breeding season approaches, the feed should be increased, so that the boar will be in good condition. While not in service, ample exercise should always be insisted upon, even if it must be urged by the whip. Exercise is productive of well-developed muscles and general thrift; with these two conditions, activity and soundness of reproductive organs will usually follow. During the breeding season it will not be possible for the boar to get the same amount of exercise, and accordingly care must be taken that his energies are not wasted by unnecessary service. Careful feeding will do much to counteract this disadvantage. It must always be remembered that the drains on a boar during service are severe, especially if 50 or 60 sows are served. This will require ample feed, with as much exercise as possible, and, with care in his treatment, will bring about good results. A fully matured boar should not serve more than two sows daily, preferably one in the morning and one in the afternoon, and can serve 50 or 60 in a season without difficulty.

Coburn[a] advises that where farmers own but 12 or 15 sows each, three or four breeders might purchase a boar and use him in common, thus saving materially in expense. Cownie[b] states that he has found

[a] Swine Husbandry, pp. 93, 94.

[b] Kansas State Board of Agriculture, Thirteenth Biennial Report, p. 693.

it well to have at least two boars in the herd, even though the herd be small in numbers.

SANITATION IN THE HOG LOT.

The greatest drawback to the hog industry which breeders in this country have to contend against is the presence of highly contagious diseases known as hog cholera and swine plague, or, popularly, as "cholera," and were it not for the fecundity of these animals their profitable production would be out of the question. These two diseases are so closely identical that post-mortem examinations are usually required to distinguish between them. Indeed, only recently (on October 1, 1903) De Schweinitz and Dorset, of the Bureau of Animal Industry, announced the discovery of a fatal disease of hogs which is caused neither by the hog-cholera nor swine-plague bacilli, and which is apparently a very frequent cause of swine fatalities.

For the present the breeder can regard these diseases as identical, so far as his practical management of the herd is concerned.

There are a few fundamental facts which he must remember if he is to avoid losses by reason of the presence of hog cholera or swine plague in the herd. The first is that they are specific germ diseases, disseminated by bacteria, and the contagion can not be spread from one animal to another or from one herd to another except by these minute organisms. They may be carried in a multitude of ways—by the hogs themselves, on the clothing of persons, on vehicles, in feed, by dogs, birds, and other animals, or by streams. The breeding or feed of a hog can not cause either disease, although bad methods may so weaken constitution and vitality that the animal becomes more susceptible than would otherwise be the case; second, diseases caused by bacteria may be prevented in large part by thorough disinfection; third, bacteria are generally preserved in filth, and, therefore, scrupulous cleanliness will go far toward preventing outbreaks of disease in herds of hogs.

PREVENTION OF DISEASE.

Cleanliness.—Preventive measures must be most relied upon. Hogs must be given dry and well-ventilated quarters, which must be kept clean. Contrary to common belief, hogs have some habits which raise them above other domestic animals from the standpoint of cleanliness. For example, unless compelled to do so, a hog will not sleep in its own filth. If part of the floor of the pen is raised and kept well bedded with straw, while the rest is not, all excrement will be left on the unbedded portion of the floor, and the bed itself will always be clean. Feeding and drinking places should be clean and the water supply pure. Unless the origin is known to be uncontaminated and there has been no possibility of infection during the course, hogs should not be allowed access to streams. Wallows should be kept filled up as much as possible. At least once a month the quar-

ters should be disinfected with air-slaked lime or a 5 per cent solution of crude carbolic acid. If a hog dies from any cause, the carcass should be burned or buried and the pens thoroughly disinfected at once.

Breeding and feeding.—While inbreeding is the surest and quickest means to fix type, the system weakens vitality unless very carefully followed. For this reason closely inbred hogs are more susceptible to cholera than those whose constitutions have not been impaired by the system. The straight corn diet which many hogs receive from one year's end to the other also lessens vitality, and the researches of the Wisconsin Experiment Station have shown that this is probably brought about by actually retarding the development of the vital organs. A minimum of inbreeding and a varied diet, including, especially for breeding stock, ample range, will therefore better enable the herd to resist the attacks of disease.

Isolated houses.—The advantage of a number of small, portable houses, each accommodating a few hogs, rather than one large piggery for the entire herd, has been referred to in the foregoing pages. In districts where cholera is prevalent these are undoubtedly the best shelters. They make it more difficult to carry contagion to all animals in the herd, and the destruction of one of them in case of an outbreak does not entail a great expense. An added advantage is that they may be moved from place to place as needed. While more work is necessary in feeding, the convenience and safety from their use more than offsets this disadvantage.

Quarantine.—Whenever new animals are brought to the farm, or when animals are brought home from shows or from neighboring herds, they should be kept apart from the rest of the herd for at least three weeks. If they have been exposed, the disease will manifest itself within this time, and the sick animals can be treated or killed and disposed of at once.

If cholera breaks out in the neighborhood the farmer should maintain a strict quarantine against the infected herds. He should refrain from visits to farms where they are located and should insist on his neighbors staying out of his hog lots. Intercourse of all kinds at this time should be carefully restricted. The contagion is so easily carried that the strictest measures are justifiable.

TREATMENT OF DISEASES.

As soon as sickness appears in the herd the unaffected hogs should be at once removed to clean, disinfected quarters, preferably without much range; for by running over pastures they may come in contact with contagion. Their feed should be carefully regulated and, if they have previously been on pasture, should include some green feed, roots, or an abundance of skim milk.

The quarters in which the sickness first appeared should be thoroughly cleaned, all bedding and rubbish burned, and loose boards and old partitions torn out and burned. If the pen is old, knock it to pieces and burn it. Disinfect pens and sleeping places, using air-slaked lime on the floors and the carbolic-acid solution on the walls and ceilings. Whitewash everything. If a hog dies burn the carcass or bury it deeply out of the reach of crows, buzzards, or dogs. If possible, do not move the carcass from the place where it falls; but if this can not be done the ground over which it is dragged should be disinfected. Hog cholera bacilli can live in the ground for at least three months. Care must be taken to maintain an absolute quarantine between the sick and well hogs. The same attendant should not care for both lots unless he disinfects himself thoroughly after each visit to the infected hogs. Dogs should be confined until the disease is stamped out.

Treatment of hogs suffering from cholera or swine plague is not always satisfactory. The disease runs its course so rapidly that curative measures are more or less ineffectual, and prevention of an outbreak should be relied upon rather than the cure of sick animals. Dr. Salmon[a] states that the following formula has been successful in less virulent outbreaks when properly administered as soon as signs of sickness are shown:

	Pounds.
Wood charcoal	1
Sulphur	1
Sodium chlorid	2
Sodium bicarbonate	2
Sodium hyposulphite	2
Sodium sulphate	1
Antimony sulphid (black antimony)	1

"These ingredients should be completely pulverized and thoroughly mixed. In case there is profuse diarrhea the sulphate of sodium may be omitted."[a]

A large tablespoonful once a day for each 200 pounds of live weight of hogs to be treated is a dose. The medicine should be thoroughly mixed with the feed, which should be soft, made of bran and middlings, corn meal and middlings, corn meal and ground and sifted oats, or crushed wheat, mixed with hot water. It the hogs are too sick to come to the feed, they should be drenched by pulling the cheek away from the teeth and pouring the medicine in slowly. Care should be exercised, as hogs are easily suffocated by drenching. Do not turn a hog on its back to drench it.[a]

PREVENTION AND DESTRUCTION OF VERMIN.

Hogs often suffer very much from vermin. Lice are introduced from neighboring herds, and the losses in feeding are often severe,

[a] Farmers' Bul. No. 24, U. S. Dept. Agr.

especially among young pigs, when death is sometimes a secondary if not an immediate result. When very numerous, lice are a very serious drain on vitality, fattening is prevented, and in case of exposure to disease the lousy hogs are much more liable to contract and succumb to it.

Vermin are most common around the ears, inside the legs, and in the folds of the skin on the jowl, sides, and flanks. In light and isolated cases they may be destroyed by washing the hogs. In severe cases, however, especially where the whole herd is affected, thorough spraying or dipping should be resorted to. In this case a dipping tank will be a great convenience.

One of the most effective and cheapest preparations to use as a dip is a 2 per cent solution of creolin. The common tobacco dips used for sheep scab are also efficacious. If the hogs are washed, apply the solution with a broom; if they are sprayed, use an ordinary spray pump; for dipping, use a dipping tank. When being washed or sprayed the hogs should stand on a tight board floor.

Newly purchased hogs should be carefully examined for vermin, and they should not be turned with the herd until they are known to be free from these pests.

When the herd is found to be badly infested with lice, all bedding should be burned and loose floors and partitions torn out. Old boards and rubbish should be burned. The quarters should then be thoroughly disinfected by spraying with one of the solutions mentioned. (The creolin solution is good.) After disinfection, as in the case of a disease outbreak, everything about the place, inside and out, should be thoroughly whitewashed.

In these remarks on sanitation no attempt has been made to go into the details of the diseases affecting hogs or their treatment. They are simply intended to call attention to the simple measures which may be used by any farmer to avoid, to a large extent, the decimation of his herd by epidemics. Cleanliness and rational methods of management are relied upon by thousands of farmers to keep their herds in health and vigor. They are the marks of the good farmer and successful hog breeder.

RECENT AMERICAN EXPERIMENTAL WORK.

RECENT EXPERIMENTAL WORK IN PORK PRODUCTION.

INTRODUCTION.

In presenting the following review of experimental work, no attempt is made to give a complete compilation of all the work that has been done in pork production; a résumé of this work would be simply a repetition of what has previously been accomplished in a more thorough manner by others. During recent years, however, the experiment stations have paid a very large amount of attention to this phase of animal husbandry, some of which has the highest value to the producer; and this work has not been compiled heretofore.

In this bulletin complete reviews are given of those experiments only where methods or results are in dispute (such as the relative value of feeding grain whole or ground), or where a practically new feed is being used, to note its effects (such as cotton-seed meal, which heretofore has been regarded as out of the question as a hog feed). Information on grain fed whole or ground and on the feeding of cotton-seed meal is always in order, and their importance, both to the farmer and to the experimentalist, is such that a view of the entire field is necessary to a proper and intelligent discussion of the subject. Where a method has become practically obsolete in hog feeding—such, for example, as cooking—very little recent study has been done by experiment stations.

In studying the results of experimental work it is important to bear in mind that different conditions influence strongly the work of different stations. At the conference of animal husbandry workers in Chicago during the International Live Stock Exposition of 1902, Prof. W. A. Henry called attention to this fact. He pointed out that an "average," to be of any scientific value, should summarize work conducted with all conditions—such as age of animals, breeding, kinds of feed, care, management, and season of the year—as uniform as possible, and should represent the results of the labor of one man conducted at the same station and extending over a very considerable term of years. These factors are all of the highest importance and it is essential that they be considered in studying results. Good feeders know that animals of different ages feed differently, that breed is often an influential factor, that all feeds do not have the same value in the ration, and that good shelter and regular and skillful feeding are highly essential to secure profitable results. It is also readily apparent that, if all other conditions are equal, an experiment conducted in Maine to compare the value of corn meal with that of whole

shelled corn can not be averaged, but only compared, with one of a similar nature conducted in Iowa or Oregon; the factor of climate is important and influential. The results of an experiment with hogs fed in the summer months are not to be averaged with those obtained with similar animals under exactly similar conditions of feed, care, and management during the winter. Even where all conditions are similar and every care has been taken to make them as uniform as possible, seasonal variations of climate may inject another factor of error. The results of two experiments conducted by a corn-belt station, the one during 1901, the other in 1902, could not be averaged with propriety, although they were conducted as uniformly as possible, because the year of 1901 in the central west was one of drought and the summer exceptionally long and hot; whereas weather conditions were exactly the reverse during 1902, when an unusual amount of rainfall was recorded, with very low temperatures during the summer.

Again, though not so frequently recognized, the personality of the experimentalist has a great deal to do with the value of his work. It is unfortunate that frequently a man is placed in a position to conduct experimental work whose qualifications for it are not of the highest order. Results from his work are not so valuable as those from men who combine a large fund of scientific information with an intimate knowledge of the practical care and management of the animals fed.

If the farmer will bear in mind the influence of these modifying conditions, he can better realize the difficulties that surround experimental feeding; he will better understand their value, and will find himself listening more carefully to the advice of experiment station workers, reading bulletins with more confidence, and condemning less hastily what seems to be inaccurate. If each farmer regarded himself, in a way, as an experimentalist and should spend a small amount of time in keeping records of his operations, studying the results with the aid of the information at his command, and if he should at the same time keep in touch with the authorities of his experiment station, there is little doubt that many of the problems now perplexing farmers would be brought much nearer to a solution and the business of feeding live stock rendered more systematic and profitable.

While much may be said against averages, it is a fact that, unless the conditions vary greatly and the extremes are too divergent, a general idea is conveyed by an average that has a practical utility, in that it shows the general results that may be expected to follow certain practices. The averages shown in these pages should be regarded in this light.

As a general rule, the figures given in the following pages relating to experimental work are taken from the station bulletins exactly as they appear in those publications. In some cases obvious typographical errors have been corrected.

PRINCIPLES OF FEEDING.

PHYSICAL CHARACTER OF FEEDS.

Feeds, as regards their physical characteristics, are generally divided into two classes, namely, concentrated feeds, or concentrates, and bulky feeds, commonly called coarse fodder, roughage, or forage. The seeds of plants, whole or ground, and all such feeds as are produced from the by-products of commercial establishments (mills, packing houses, etc.), supply a large amount of nutriment in small bulk, and hence are called concentrates. The body of plants, in the form of hay of all kinds, straw, green fodder, pasture grasses, and roots and tubers, gives us bulky feed or roughage. Vegetables, such as pumpkins, and the waste fruit of orchards are often fed to animals and are in the category of bulky feeds. All of these supply a relatively small amount of nutriment and a large amount of feed material. Milk is, properly speaking, a bulky feed when fed to rather mature animals, particularly when skimmed. For young animals whole milk is the most "complete" feed known, but it is too expensive to feed any but the youngest animals, or those that are to be brought to the highest condition in the shortest possible time.

RELATION OF BULKY FEED TO LENGTH OF ALIMENTARY CANAL.

The amount of bulky feed required is different with different species of animals and depends upon the complexity of the feed of the animal; and the kind and variety of feed in turn have a direct relation to the length and complexity of the alimentary canal. For example, in a state of nature carnivorous animals, such as those of the cat and wolf tribe, have very short and simple alimentary canals, and live upon flesh, which is a very simple diet. Herbivorous animals—that is, those that subsist exclusively upon grasses, browse, etc., such as the horse, ox, sheep, and goat—have the most complicated digestive apparatus and eat a very great variety of feeds. Between these two classes we have those animals that live both on a flesh and a vegetable diet, and with them the alimentary canal is longer and more complicated than that of the carnivora, but shorter and less complicated than that of the herbivora. The pig belongs to this class, which is denominated the omnivora. Domestication has changed the habits of animals considerably, and in so doing has changed the internal characteristics of the body. Domestic dogs and cats have been brought to subsist on a diet in which there is a rather large amount of vegetable matter. Pigs are fed almost exclusively on a vegetable diet and only occasionally indulge their appetite for an animal diet. As a consequence of this variation in the range of feed eaten in domestication, these animals have a longer and more complicated digestive tract than the same species in the wild state.

FUNCTION OF BULK IN THE FEED.

The function of bulk in the feed is more than the mere furnishing of nutriment; for, in a mechanical way, it aids digestion. In the ruminant animals especially there is an enormous stomach content which must be comfortably filled if digestion is to be carried on properly. Hence, with this class of animals a great amount of hay, etc., is required, and they can also give the best returns from a bulky feed and subsist more satisfactorily than any others on hay or straw alone. Pigs require less bulky feed than other domestic animals, but recent experiments show that, to a certain extent, hay feeding is very valuable in pork production. Where herbivorous animals have been maintained for an extended period on feed which was exclusively of a concentrated nature, derangement of digestion has resulted.

CHEMICAL COMPOSITION.

From a chemical standpoint, the constituents of feeds that most immediately concern the feeder are the nitrogenous substances, generally termed protein compounds, which contain a large percentage of nitrogen; the starches, sugars, etc., called carbonaceous substances or carbohydrates, from the fact that they are composed of carbon, with hydrogen and oxygen in the proportions in which they occur in water (they are termed "nitrogen-free extract" in chemical analysis), and fat, found in analysis under the heading of "ether extract." Ash is also of importance and often should be more carefully considered when feeders are making up their rations.

WATER CONTENT.

The most valuable portion of feeds is the water-free substance, or dry matter, of the feed. This is what remains of a feed after heating it in a drying chamber at or near the boiling point until repeated weighings show no change in weight. The amount of water present in feed is obviously an important factor. While water yields neither tissue-building material nor energy, it enters into the composition of the body and is indispensable. When animals are compelled to take into the system water beyond the normal amount, undesirable results will follow. When animals are fed exclusively on roots or skim milk they do not receive more than enough to maintain bodily functions. This is readily understood when we consider that roots contain about 90 per cent and skim milk about 88 per cent of water. On the other hand, hay does not ordinarily contain more than 15 to 20 per cent of water, while grains, leguminous seeds, and milling products contain only about 10 per cent. The water content of feed is very much influenced by weather conditions, especially in the case of roughage, which absorbs large amounts of moisture in wet weather.

ENERGY.

A factor that is being more carefully considered in studying the value of a feed, or a ration, is the amount of energy which it will yield. When feed is utilized in the animal body a certain amount of heat is evolved, the process not being unlike the consumption of fuel in a furnace. This heat is converted into the energy which is necessary whenever work is performed. It is apparent, then, that a horse at hard work will need a ration that will supply more energy than one at moderate or light work. The term work, however, has a wider significance than denoting actual muscular effort in the performance of a task. The operations of mastication, deglutition, and the contraction of the walls of the stomach and intestines involve muscular action, both voluntary and involuntary; in the movements of the heart and lungs and the circulation of the fluids of the body, muscular action of some kind is constantly going on; in fact, the performance of nearly every function of the body is actually some form of work involving the expenditure of energy, accompanied by the evolution of heat and maintained by the energy-yielding material in the feed. The amount of work performed by an animal in the ordinary processes of "hustling for a living"—that is, finding its feed, eating it, and digesting it—is enormous. In experiments, reviewed in the following pages, with suckling pigs, Miss Wilson[a] found that the young animals required nearly as much energy per square meter of surface as had been found by other investigators to be required by a man at hard work. It is therefore readily apparent that the heat-producing powers of feed have a very much more important function than the maintenance of bodily warmth. The unit of energy used in computing the value of a feed from this standpoint is the "small" calorie, which is the amount of heat necessary to raise 1 gram of water 1° C.

Fats yield a greater amount of energy than either the carbohydrates or protein, there being very little less energy given up by proteids when digested than by carbohydrates.

RELATION OF FEED TO THE ANIMAL BODY.

We have seen that the most important constituents of feed are the proteids, the carbohydrates, and the fats. These are practically all that the feeder considers in making up his rations, although the physiologist must consider other compounds which exist in smaller quantities. In the body we find, in the water-free matter, the proteids, the fat, and the ash.

The following table shows graphically the relation between the

[a] See pp. 232-236.

constituents of the feed and those of the body—that is, the disposition of the feed:

Disposition of feed in the body.

Feed.	Body.
Water	Water.
Proteids	Proteids.
Carbohydrates	Fat.
Fat	
Proteids (rarely)	
Ash	Ash.
Fat	Energy.
Carbohydrates	
Proteids	

It is seen that the water of the feed reappears as the water in the body. The proteids in the feed form the proteids in the body. The fat of the body is formed from the carbohydrates and fat of the feed and occasionally from the proteids. The ash of the body, such as the mineral matter of the bones, comes from the ash of the feed. The three principal feed constituents—fat, carbohydrates, and protein—yield energy in the order named, fat yielding the most energy for an equal weight of feed. The carbohydrates and proteids are practically equal in heat-yielding power.

Now, as different animals have different demands made upon them, we must expect them to require these constituents of feed in different proportions. To be more explicit, a young and growing animal is building up tissue rapidly, and this should be largely muscular and bony if the best health is maintained. Muscular tissue is largely made up of proteids, and we therefore expect a large amount of protein matter in the feed. There should also be a plentiful supply of mineral matter and phosphates so that the skeleton may be properly built up. As milk is rich in nitrogenous material, we find it an excellent feed for growing animals. Again, animals that are to be fattened rapidly must have a large amount of fat-producing material in the ration, for which reason farmers find corn such a valuable feed for this purpose. Horses that are at hard work require a ration that will give an ample supply of energy. The large amount of energy yielded by fattening rations and heavy-working rations has an interesting bearing on the shelter requirements. Steers that are on full feed can enjoy themselves in the coldest weather if provided with a simple shed that will protect them from cold winds, rain, and snow, and human beings readily recognize the fact that where a large amount of exercise is indulged in, with ample food, a much greater amount of cold may be endured than where no exercise is taken and the ration is light.

DIGESTIBILITY OF FEED.

The amount of nutritive material which an animal can get from his feed is a very important factor. It is obvious that when skim milk or roots are fed alone immense quantities must be eaten to give a sufficient amount of nutritive material. A similar condition is met

with when feeds having a low digestibility are given. For instance, when animals are wintered at straw stacks they acquire large stomachs by reason of gorging themselves with coarse, bulky feed, and generally have a half-starved appearance because they are not able to obtain from such feed an adequate amount of nourishment to maintain flesh and condition. Hay and straw contain large amounts of crude fiber, which is composed of carbohydrate material, largely cellulose, and which is only partially digestible. The crude fiber in grains is insignificant, except in the hulls, and hence their higher digestibility.

THE NUTRITIVE RATIO.

In discussing feeding, the term "nutritive ratio" is frequently met. This means simply the ratio between the total amount of digestible protein in a ration (that is, one day's feed) to the total amount of digestible carbohydrates plus 2.25 times the digestible fat. The fat is of greater value for the purpose of yielding energy than the carbohydrates, and chemists have determined that this ratio is about 2.25; hence the reason for this factor in the computation of a ration. As the functions of the fat and the carbohydrates are very similar, the reason is apparent for the addition of the former. There are many publications available that discuss in detail the computation of rations. One of the principal things to avoid is getting a ration which, while correct, so far as nutritive ratio is concerned, can not be fed successfully on account of its low digestibility or high water content.

PREPARATION OF FEED AND METHODS OF FEEDING.

Investigation of the value of different methods of preparing feed was one of the earliest efforts of the experiment stations made in animal husbandry. The questions that relate to this subject were at once recognized to be of the highest importance and their study very interesting. The subject divides itself into three general sections: (1) Cooking, (2) grinding, and (3) wetting, or soaking.

COOKING.

The utility of cooking feed for animals, and especially for pigs, was given most attention in the days previous to investigations by experiment stations. The subject demands only brief consideration here. Cooking feed is no longer regarded as an economical practice for fattening animals. However, for breeding stock and sick animals, and for animals which it is desired to put into the very highest condition, cooking may be practiced with good results, if expense is disregarded. Pigs so fed show marked thriftiness and health.

GRINDING.

The question whether grain should be fed whole or ground is by no means settled; thus it is one that differs radically from that of cooking, and is of much *more importance* to feeders.

THE PHILOSOPHY OF GRINDING GRAIN.

The theory of grinding grain is that when the feed is in the condition of a meal it is more readily or quickly available for digestion. It is fallacious to claim that a feed given as meal contains more digestible matter than the same feed before it has been reduced to the condition of meal; for that is a thing that is obviously impossible. But it is not, perhaps, incorrect to say that the digestive fluids may be more effective in their action on feed that has been crushed or ground, and that less undigested matter is voided by the animal than when whole grain is given. The amount of the feed that is absorbed (digested) in its passage through the body, plus the undigested nutrient content of the excrement, practically equals the total digestible matter in the feed before eaten. All practical feeders readily recognize the great possibility of loss by way of the excrement when feeding steers on shelled or ear corn, and, to obviate this, they use hogs to consume the waste. Some waste is inevitable. There can not be perfect feeds or perfect digestions; but we may avoid wasteful methods, and the feeder's problem is to render the loss of feed in the manure as small as possible. It is unnecessary to remark that grain which is swallowed without being masticated is much more likely to pass undigested than if thoroughly masticated before swallowing. The kind of grain that is more readily masticated when fed whole would therefore seem to be less in need of grinding than that which is more generally swallowed without thorough mastication.

EXPERIMENTS TO DETERMINE THE AMOUNT OF UNDIGESTED GRAIN.

The Central Experimental Farm,[a] at Ottawa, Canada, conducted experiments to study this subject with pigs. Whole grain was fed and the excrement was collected for one day, the whole grain in it washed and weighed, the weight per bushel estimated, and the germinating power determined. The following table shows the results:

Loss in feeding whole grain.

Ration.	Amount consumed.	Amount unmasticated.	Estimated weight per bushel.	Germinating power.
	Lbs.	*Lbs. Oz.*	*Lbs.*	*Per cent.*
Oats, soaked 54 hours, all pigs would eat clean, and 3 pounds skimmed milk per head daily	14	2 6	22¼	11
Barley, supplemented as above	17	2 2	35	0
Pease, supplemented as above	17	2	(a)	0
Indian corn, supplemented as above	11	8	40½	8

[a] Amount too small to estimate.

The results of this experiment are very interesting. Note that the amount of grain passed whole is influenced by the size and kind of

[a] Bul. No. 33.

the grain; for example, oats and barley were passed in much larger amounts than pease or corn. However, there was practically no difference in the percentage of loss in weight, and the germinating power of the excreted grains does not seem to have depended on their size. It is interesting to compare these results with the tables in the following pages, which show the results of the experiment station work with grinding grain.

EXPERIMENTS WITH GROUND AND UNGROUND GRAIN.

Ground compared with whole corn.—Numerous stations have reported experiments with ground corn compared with whole shelled corn. There is a considerable amount of variation between them, the results in some cases showing as great a loss from grinding as is gained in others. The following table shows results that have been obtained at experiment stations in various parts of the country. Where corn was fed on the cob the amount is reduced to equivalent weights of shelled corn or not included in the averages:

Results of experiments with ground and unground corn.

Ration.	Number of pigs.	Average weight, beginning.	Total gain.	Number of days fed.	Average daily gain.	Total feed eaten.			Feed per 100 pounds gain.		
						Whole grain.	Meal.	Milk.	Whole grain.	Meal.	Milk.
Alabama:[a]		*Lbs.*	*Lbs.*		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
Corn meal	2	78	55	21	1.31	.....	182	.....	.....	330	.....
Whole corn	2	80	28	21	.66	155	.....	.....	536	.....	.....
Corn meal	2	172	67	21	1.59	.....	216	.....	.....	323	.....
Whole corn	2	104	36	21	.85	138	.....	.....	384	.....	.....
Maine:[b]											
Corn meal	3	86	385	196	.65	.....	.....	.....	.....	.....	.....
Whole corn	3	86	387	196	.66	.....	.....	.....	.....	.....	.....
Corn meal	3	165	252	84	1.00	.....	.....	.....	.....	.....	.....
Whole corn	3	165	271	84	1.08	.....	.....	.....	.....	.....	.....
New York State:[c]											
Corn Meal	4	110	253	63	1.00	.....	.....	.....	.....	269	.....
Corn on cob	4	112	174	63	.69	.....	.....	.....	401	.....	.....
Ohio:[d]											
Corn meal, cooked	3	191	404	112	1.20	.....	2,386	.....	.....	590	.....
Corn on cob, cooked	3	202	167	112	.50	2,109	.....	.....	1,260	.....	.....
Corn meal	3	205	383	112	1.14	.....	2,116	.....	.....	552	.....
Whole corn	3	199	404	112	1.20	2,039	.....	.....	505	.....	.....

[a] Bul. No. 8, Canebrake Sta.

[b] An. Rpts., 1887 and 1888. The rations in the first experiment included raw potatoes and skim milk. Those pigs in the second were fed corn meal and water and corn and water.

[c] An. Rpt., 1893. A supplementary ration to give variety was fed both lots. The "feed per 100 pounds gain" is dry matter.

[d] Sixth An. Rpt. The weights of the feed eaten by the lots fed whole corn in these experiments represented equivalent amounts in shelled corn, the weight of the ear corn being thus reduced to show the actual amount eaten.

Results of experiments with ground and unground corn—Continued.

Ration.	Number of pigs.	Average weight, beginning.	Total gain.	Number of days fed.	Average daily gain.	Total feed eaten.			Feed per 100 pounds gain.		
						Whole grain.	Meal.	Milk.	Whole grain.	Meal.	Milk.
West Virginia: [a]		*Lbs.*	*Lbs.*		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
Corn-meal	6	195	361	28	2.15	.....	1,699	.....	.....	471	.....
Whole corn	3	239	141	28	1.68	819	.....	.....	579	.....	.....
Corn meal	6	95	581	56	1.73	.....	2,384	.....	.....	410	.....
Whole shelled corn, soaked	6	95	555	56	1.65	2,138	.....	.....	385	.....	.....
Kentucky: [b]											
Corn meal	2	100	175	63	1.39	.....	753	.....	.....	430	.....
Whole corn	2	100	182	63	1.44	780	.....	.....	429	.....	.....
Corn meal	3	149	113	28	1.35	.....	286	.....	.....	253	.....
Whole corn	3	196	65	21	1.03	357	.....	.....	549	.....	.....
Missouri: [c]											
Corn meal	4	160	638	78	2.04	.....	3,196	.....	.....	501	.....
Whole corn	4	150	594	78	1.90	2,864	.....	.....	482	.....	.....
Corn meal	4	85	250	116	.54	.....	1,612	.....	.....	645	.....
Whole corn	4	86	164	116	.35	1,239	.....	.....	755	.....	.....
Wisconsin: [d]											
Corn meal	10	255	528	30	1.76	.....	2,004	1,002	.....	380	190
Whole corn	10	251	420	30	1.40	1,815	.....	908	432	.....	216
Corn meal	9	346	1,348	70	2.13	.....	5,968	.....	.....	443	.....
Whole corn	9	354	1,235	70	1.96	5,947	.....	.....	481	.....	.....
Corn meal	10	223	1,076	70	1.53	.....	5,236	.....	.....	487	.....
Whole corn	10	225	789	70	1.12	4,665	.....	.....	591	.....	.....
Corn meal	9	210	1,348	84	1.79	.....	5,956	.....	.....	442	.....
Whole corn	9	212	984	84	1.30	4,926	.....	.....	501	.....	.....
Corn meal	7	198	576	63	1.30	.....	2,660	.....	.....	462	.....
Whole corn	7	183	552	63	1.25	2,340	.....	.....	424	.....	.....
Corn meal	8	187	992	84	1.47	.....	4,698	.....	.....	473	.....
Whole corn	8	184	830	84	1.23	4,137	.....	.....	500	.....	.....
Corn meal	8	184	1,030	84	1.53	.....	4,617	.....	.....	448	.....
Whole corn	8	184	799	84	1.19	3,914	.....	.....	489	.....	.....
Corn meal	19	186	2,132	84	1.34	.....	10,794	.....	.....	507	.....
Whole corn	19	186	2,136	84	1.34	10,626	.....	.....	497	.....	.....
Corn meal	14	175	1,938	98	1.41	.....	9,275	.....	.....	479	.....
Whole corn	14	174	1,571	98	1.15	8,778	.....	.....	559	.....	.....
Corn meal	12	148	1,038	84	1.03	.....	5,745	.....	.....	553	.....
Whole corn	12	145	893	84	.89	5,256	.....	.....	588	.....	.....
Corn meal	3	72	218	84	.89	.....	979	.....	.....	449	.....
Whole corn	3	70	234	84	.93	1,038	.....	.....	444	.....	.....
Corn meal	3	80	166	84	.66	.....	961	.....	.....	579	.....
Whole corn	3	80	169	84	.67	1,004	.....	.....	594	.....	.....
Corn meal	3	134	274	91	1.00	.....	1,407	.....	.....	513	.....
Whole corn	3	133	255	91	.93	1,426	.....	.....	559	.....	.....
Average of 19 trials (where total feed is reported) with 297 pigs									524	479	.....

[a] Bul. No. 59.

[b] Bul. No. 19.

[c] Buls. Nos. 1 and 10, Agricultural College.

[d] Fifth and Thirteenth to Nineteenth An. Rpts. In all but the first test meal, such as shorts or middlings, was fed to give variety to the ration and give a good appetite and steady gains. It was in the same proportion to both lots in each test.

The results detailed above show a preponderating amount of evidence in favor of corn meal, judging purely from the basis of feed required for 100 pounds of gain and disregarding the expense of grinding. The average for 19 trials, with 297 pigs, where the amount of feed eaten is reported is 524 pounds of grain required per 100 pounds of gain when corn is fed whole in the form of shelled corn, and 479 pounds when fed ground, a difference of nearly 8.59 per cent in favor of grinding. This is considerably higher than the value usually given for corn meal, and may be explained to some extent by the large amount of feed required to make a given amount of gain in some of the experiments, notably the first at the Ohio Station, which must have been due to extraordinary conditions. Careful researches show that an exact estimate can not yet be made of the comparative value of shelled corn and corn meal. It is worthy of particular attention, however, that in these experiments there were only nine instances out of twenty-six where the value of the two feeds was equal or in favor of whole grain, and in one of the latter, the first Missouri test; although the gains are considerably in favor of the pigs on corn meal, they were more economically made by the pigs on whole corn. The instances that favor whole grain are the Maine experiments, the first in Ohio, the second in West Virginia, the first in Kentucky, the first in Missouri, and the fifth, eighth, and eleventh in Wisconsin.

The researches of Henry in Wisconsin have been the most exhaustive that have been undertaken on this subject. In the Nineteenth Annual Report of the Wisconsin Station he publishes the following summary of seven years' winter feeding "to determine the relative merits of ground and unground corn for fattening hogs." There were 210 hogs fed in all:

Utility of ground grain.

Year.	Number of pigs in each lot.	Average weight at beginning.	Condition at beginning.	Saved or lost.
		Pounds.		
1896	9	350	Thin	8 per cent saved by grinding.
	10	224	Fat	17.6 per cent saved by grinding.
1897	9	211	Rather fat	11 per cent saved by grinding.
	7	190	do	9 per cent lost by grinding.
1898	8	185	do	5.4 per cent saved by grinding.
	8	184	do	8.4 per cent saved by grinding.
1899	19	186	do	2 per cent lost by grinding.
1900	14	175	do	15 per cent saved by grinding.
1901	12	146	do	6 per cent saved by grinding.
1902	6	71	Fair	1 per cent lost by grinding.
	6	80	do	3 per cent saved by grinding.
	6	133	Rather fat	8 per cent saved by grinding.

In these experiments no allowance was made for cost of grinding. In nine cases grinding showed a saving of feed, the highest being 17.6 per cent and the lowest 3 per cent. In the three cases where there was a loss it was 9 per cent, 2 per cent, and 1 per cent, respectively.

Two experiments that have a very close bearing on this subject, but are not included in the above table, are reported from the New Hampshire and Colorado stations.

In New Hampshire Burkett[a] compared the feeding values of corn in ear with that of corn-and-cob meal. The lot receiving whole corn gained an average of 0.81 pound per day, at a cost of 333 pounds grain and 892 pounds skim milk per 100 pounds of gain. The meal-fed lot raged 0.87 pound daily gain, at a cost of 319 pounds of grain and pounds of skim milk per 100 pounds gain, a difference of 4 per nt in favor of grinding. The Colorado Station[b] made six tests with s averaging 62 and 63 pounds to compare ground and whole corn. n ground corn made an average daily gain of 0.52 pound, con- ning 580 pounds of grain and 90 quarts of skim milk for each 100 nds of gain. The pigs on whole corn made an average daily gain .44 pound, consuming 670 pounds of grain and 120 quarts of milk each 100 pounds of gain.

The only definite conclusion that can be drawn from these figures is that it is beyond anyone to say that an advantage may be expected to follow the feeding of corn meal sufficient to pay the cost of grinding. If corn sells on the open market at 50 cents per bushel of 56 pounds and grinding costs from 3 to 5 cents per bushel, a saving of 10 per cent by such methods would be very good economy; but if corn falls to 25 cents the cost of grinding must be lessened to make meal feeding profitable.

Pease.—An experiment with pease is reported from the Central Experimental Farm of Canada,[c] the results of which follow:

Ground compared with whole pease.

Ration.	Number of pigs.	Average weight at beginning.	Average weight at close.	Average gain.	Number of days fed.	Average daily gain.	Feed per 100 pounds gain.	
							Grain.	Milk.
		Pounds.	*Pounds.*	*Pounds.*		*Pounds.*	*Pounds.*	*Pounds.*
Ground, soaked 54 hours	4	62	224	162	126	1.28	276	468
Whole, soaked 54 hours	4	100	207	107	84	1.27	333	235

This experiment does not show any difference in the feeding value of ground pease as compared with whole pease, so far as daily gains are concerned, but the pigs on ground pease required 17 per cent less

[a] Bul. No. 66. [b] Bul. No. 40. [c] Bul. No. 33.

grain than those on whole pease. The results with both feeds were satisfactory.

Grinding small grain.—The amount of material available on the subject of grinding small grain is not so voluminous as that pertaining to corn. In the United States a great amount of the oats, wheat, barley, or rye fed is in the form of mill products and is, of course, ground. These feeds are, moreover, generally used as supplements to corn, and the greater attention has been directed to methods of corn feeding on this account. In common practice, perhaps, these grains are ground more generally than corn, as they are usually much harder. Their greater liability to pass through the animal undigested shows the correctness of such practice.

The following table shows results obtained at five experiment stations, comprising ten tests in all, with a total of 69 pigs:

Effect of feeding ground small grain.

Ration.	Number of pigs.	Average weight, beginning.	Total gain.	Number of days fed.	Average daily gain.	Feed eaten.			Feed per 100 pounds gain.			Cost per 100 pounds gain.	
						Whole grain.	Meal.	Skim milk.	Whole grain.	Meal.	Skim milk.	Whole grain.	Meal.
		Lbs.	*Lbs.*		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Dolls.*	*Dolls.*
Wisconsin: [a]													
Ground oats ½, corn meal ½	3	.....	457	120	1.27	.....	1,839	.....	.....	403	.....	.....	.....
Ground oats ½, corn meal ½	3	.....	371	120	1.03	.....	1,593	.....	.....	429	.....	.....	.....
Whole oats ½, corn meal ½	3	.....	296	120	.82	1,457	.....	.....	492	.....	.....	.....	.....
Whole oats ½, corn meal ½	3	.....	246	120	.68	1,388	.....	.....	564	.....	.....	.....	.....
Oregon: [b]													
Chopped oats and wheat	2	151	331	119	1.39	.....	1,663	.....	.....	484	.....	.....	5.90
Whole oats and wheat	2	158	308	119	1.29	1,830	.....	.....	594	.....	.....	7.20	.....
Utah: [c]													
Chopped wheat, dry	2	126	330	135	1.22	.....	1,421	.....	.....	431	.....	.....	.....
Whole wheat, dry	2	148	332	135	1.23	1,474	.....	.....	444	.....	.....	.....	.....
Ontario Agricultural College: [d]													
Ground pease and barley (1:1)	3	107	390	91	1.43	.....	1,589	.....	.....	407	.....	.....	3.87
Whole pease and barley (1:1)	3	109	333	91	1.22	1,589	.....	.....	477	.....	.....	4.25	.....

[a] Sixth An. Rpt.

[b] Bul. No. 20. In this experiment the pigs were fed on oats alone for two months, and the experiment was concluded with wheat alone.

[c] Bul. No. 70.

[d] An. Rpt., 1891.

Effect of feeding ground small grain—Continued.

Ration.	Number of pigs.	Average weight, beginning.	Total gain.	Number of days fed.	Average daily gain.	Feed eaten.			Feed per 100 pounds gain.			Cost per 100 pounds gain.	
						Whole grain.	Meal.	Skim milk	Whole grain.	Meal.	Skim milk.	Whole grain.	Meal.
tawa:[a]		*Lbs.*	*Lbs.*		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Dolls.*	*Dolls.*
Pease, barley, and rye, ground, soaked 12 hours..	5	69	104	119	.87	.....	455	.....	.....	436	.....	.....	.....
Pease, barley, and rye, ground, soaked 12 hours..	4	76	134	119	1.12	.....	464	645	.....	346	481	.....	.....
Pease, barley, and rye, whole, soaked 48 hours..	5	69	87	119	.73	386	.....	.....	445	.....	.....	.....	.....
Pease, barley, and rye, whole, soaked 48 hours..	5	69	135	119	1.13	330	.....	1,869	246	.....	1,392	.....	.....
Oats, pease, barley, and ¼ part bran, ground, dry.....	4	69	126	119	1.06	.....	450	.....	.....	356	.....	.....	.....
Oats, pease, and barley, whole, dry	4	67	108	119	.90	441	.....	.....	408	.....	.....	.....	.....
Oats, pease, and barley, ground, soaked 30 hours..	4	66	124	119	1.04	.....	467	.....	.....	376	.....	.....	.....
Oats, pease, and barley, whole, soaked 30 hours..	4	66	105	119	.88	409	.....	.....	388	.....	.....	.....	.....
Oats, pease, and barley, ground, dry.....	4	101	89	76	1.17	.....	307	.....	.....	343	.....	.....	.....
Oats, pease, and barley, whole, dry	4	103	82	76	1.08	307	.....	.....	360	.....	.....	.....	.....
Average, 10 tests, with 69 pigs....	...	.....	.....	.....	.....	.....	.....	.....	473	415	.....	.....	.....

[a] Bul. No. 33, Central Expt. Farm. The mixture of pease, barley, and of rye, and oats, pease, and barley fed in these experiments were composed of equal parts of those grains.

The Colorado Station[a] studied the value of grinding both bald, or beardless, barley and common barley. Four tests were made with bald and three with common barley. The pigs on ground bald barley averaged 60 pounds at the beginning, made an average daily gain of 0.77 pound, and consumed 320 pounds of grain and 100 quarts of skim milk for each 100 pounds of gain. Those on whole bald barley averaged 58 pounds at the beginning, made an average daily gain of 0.65 pound, and consumed 370 pounds of grain and 180 quarts of skim milk

[a] Bul. No. 40.

for each 100 pounds of gain. The pigs on common barley averaged 43 pounds at the beginning. Those on ground grain made an average daily gain of 0.47 pound, and consumed 470 pounds of grain and 90 quarts of milk for each 100 pounds of gain. Those on whole grain made an average daily gain of 0.44 pound, and consumed 520 pounds of grain and 90 quarts of milk for 100 pounds of gain.

These results show a somewhat wider variation between the feeding values of whole and ground small grain than those from the experiments with corn. It should be also noted that the results are much more uniformly favorable to grinding. The approximate averages are 473 pounds of whole grain per 100 pounds of gain and 415 pounds of ground grain per 100 pounds of gain, showing an advantage in favor of grinding of 12.26 per cent.

DRY COMPARED WITH SOAKED FEED.

The general custom of soaking grain has received considerable attention from the experiment stations. In some localities a sentiment in favor of feeding meal dry is gaining ground, and some experiments have shown an advantage for this method of feeding. Pigs have been fed to compare wet and dry meal as follows:

The Indiana Station fed two lots of pigs on a mixture of equal parts of corn meal and shorts, which toward the end of the experiment was changed to hominy meal and shorts. Lot I received dry meal and Lot II received meal mixed with an equal weight of water. Both lots received all the water they desired in addition to that in the feed.

Two tests were made at the Wisconsin Station. In the first a ration of equal parts of corn meal and shorts was fed with water as wanted. In the second trial the grain was 2 parts of corn meal and 1 of shorts. Salt and hardwood ashes were supplied to all lots. In both trials Lot I received dry feed and Lot II wet feed.

In Minnesota 12 pigs were fed a ration of 2 parts of corn meal, 2 parts of shorts, and 1 part of old-process linseed meal. Two lots had their meal mixed into a thick slop with cold water, the others were fed dry.

At the Missouri Station two lots were fed wheat chops and two others a mixture of 4 parts whole wheat and 1 of bran. The wet grain was fed after being soaked thirty-six hours. The pigs, which were high-grade Berkshires, were fed in pens open to the south, and they had access to troughs in which was a mixture of hardwood ashes, coal, and salt.

In Utah three tests are reported. In the first, two lots were fed a ration of equal parts of wheat and bran in yards; in the second, two lots of pigs were fed a balanced ration of corn meal and bran, which was changed in proportion as age and weight increased; the meal to the wet-feed lot was thoroughly mixed with water, but not soaked; in the third experiment, three lots of pigs received a ration of equal parts

by weight of bran and chopped wheat. Lot I received meal that had been soaked twelve hours; Lot II, meal wet just before feeding; and Lot III, dry meal.

The Oregon Station fed 4 well-bred Berkshire pigs, two and one-half months old, at the beginning of the experiment. They received a ration of shorts from July 1 to September 5, and after the latter date a ration of equal parts by weight of chopped wheat, oats, bran, and shorts. The meal to the lot on wet feed was "thoroughly wet with cold water and allowed to stand from one feeding time to the next." Charcoal and ashes were given two or three times each week.

A brief experiment of this character that was conducted by a third-year student as thesis work at the Ontario Agricultural College is noted in the report of that institution for 1900. The hogs in both lots were of similar breeding and were fed a meal mixture of wheat and barley.

The Canada Central Experimental Farm fed four lots of pigs on a mixture of equal parts of pease, barley, and rye as follows: Lot I received whole grain soaked thirty hours, Lot II received whole grain dry, Lot III received ground grain soaked thirty hours, and Lot IV ground grain dry.

The results of all these experiments are shown in the following table:

Results of experiments with dry and wet feed.

Ration.	Number of hogs.	Average weight at beginning.	Total gain.	Number of days fed.	Average daily gain.	Total feed eaten.			Feed per 100 pounds gain.		
						Dry.	Wet.	Soaked.	Dry.	Wet.	Soaked.
Indiana:[a]											
Corn meal or hominy meal and shorts, equal parts—		*Lbs.*	*Lbs.*		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
Dry	4	60	634	146	1.08	2,282	.....	.....	359	.....	.....
Wet	4	59	645	146	1.10	.....	2,451	.....	.....	380	.....
Wisconsin:[b]											
Corn meal and shorts, equal parts—											
Dry	3	115	255	68	1.25	1,228	.....	.....	482	.....	.....
Wet	3	115	337	68	1.65	.....	1,361	.....	.....	404	.....
Corn ¾, shorts ¼—											
Dry	2	109	161	68	1.18	983	.....	.....	611	.....	.....
Wet	2	109	220	68	1.62	.....	1,040	.....	.....	473	.....
Minnesota:[c]											
Corn meal 2, shorts 2, linseed meal (O. P.) 1—											
Dry	3	29	246	112	.73	1,085	.....	.....	441	.....	.....
Do	3	33	249	112	.74	1,141	.....	.....	458	.....	.....
Wet	3	34	343	112	1.02	.....	1,501	.....	.....	438	.....
Do	3	30	269	112	.80	.....	1,234	.....	.....	459	.....

[a] Bul. No 86. [b] Fifth An. Rpt. [c] Bul. No. 22.

Results of experiments with dry and wet feed—Continued.

Ration.	Number of hogs.	Average weight at beginning.	Total gain.	Number of days fed.	Average daily gain.	Total feed eaten.			Feed per 100 pounds gain.		
						Dry.	Wet.	Soaked.	Dry.	Wet.	Soaked.
Missouri:[a]											
Wheat chop—		*Lbs.*	*Lbs.*		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs*	*Lbs.*
Dry	3	111	562	99	1.89	2,340	.....	.....	416	.....	.....
Wet	3	112	605	99	2.04	.....	2,420	.....	.....	400	.....
Whole wheat ⅔, bran ⅓—											
Dry	3	118	414	99	1.39	2,105	.....	.....	508	.....	.....
Wet	3	119	373	99	1.26	.....	2,054	.....	.....	550	.....
Utah:[b]											
Wheat and bran, equal parts—											
Dry	2	83	296	112	1.32	1,292	.....	.....	436	.....	.....
Wet	2	69	311	125	1.25	.....	1,462	.....	.....	470	.....
Corn meal and bran—											
Dry	3	99	202	75	.90	998	.....	.....	494	.....	.....
Wet	3	96	171	75	.76	.....	868	.....	.....	508	.....
Bran and chopped wheat, equal parts—											
Dry	3	91	216	110	.65	1,389	.....	.....	643	.....	.....
Wet	3	93	271	110	.82	.....	1,422	.....	.....	525	.....
Soaked	3	86	234	110	.71	.....	.....	1,360	.....	.....	581
Oregon:[c]											
Mixed grain—											
Dry	2	63	453	182	1.24	2,116	.....	.....	467	.....	.....
Wet	2	61	527	182	1.45	.....	2,320	.....	.....	440	.....
Ontario Agricultural College:[d]											
Wheat and barley—											
Dry	4	.....	.....	49	1.04	.....	.....	.....	452	.....	.....
Wet	4	.....	.....	49	.96	.....	.....	.....	.....	489	.....
Ottawa:[e]											
Pease, wheat, and barley, whole—											
Dry	4	67	432	119	.90	1,764	.....	.....	408	.....	.....
Wet	4	66	420	119	.88	.....	1,636	.....	.....	388	.....
Pease, wheat, and barley, ground—											
Dry	4	69	504	119	1.06	1,800	.....	.....	356	.....	.....
Wet	4	66	496	119	1.04	.....	1,868	.....	.....	376	.....
Average of 12 tests, with 89 pigs									444	434	.....

[a] Bul. No. 29. [b] Bul. No. 70. [c] Bul. No. 28. [d] An. Rpt. 1900. [e] Bul. No. 33.

These results show an advantage of slightly over 2 per cent in favor of soaking as compared with feeding dry. The results at Ottawa and in Missouri are worthy of particular notice. Grisdale[a] calls attention to the fact that in the Ottawa experiments a loss is shown by soaking ground grain, but the whole grain returned the better gains when fed soaked, and suggests that the result from soaking meal may not be so marked as from soaking whole grain. The Missouri results

[a] Bul. No. 33, Central Expt. Farm.

seem to present contradictory evidence in the second test, where four-fifths of the ration was whole wheat. The Utah results of soaking the meal twelve hours should be noted. They are not included in the average; if this were done, the balance would be more favorable to dry feeding.

Two experiments carried on at the Illinois Experiment Station[a] to compare soaked and dry shelled corn gave rather indefinite results. Four pigs, fed in pens, were used in each case, 2 being fed on soaked shelled corn and 2 on dry shelled corn. They had no other feed. The first test lasted from April 29, 1889, to May 27, 1889; the second, from June 10 to July 22, 1889. In the second trial the pigs were well fattened when the experiment commenced. Sixty pounds of corn were put in water at one time, at the rate of 1 bushel of shelled corn to about 8 gallons of water, and taken out as needed for feeding. The daily gains favored the pigs on soaked corn in both tests; but in the first test there was an advantage of about 4½ per cent in favor of soaking, while in the second there was an advantage of about 6½ per cent in favor of the pigs on dry corn.

THE EFFECT OF WATER CONTENT OF SLOP.

In Indiana Plumb and Van Norman[b] fed 16 purebred pigs in order to study the effect of water content of slop. The breeds were Chester White and Berkshire. They were divided into four lots of 4 pigs each, with 2 of each breed in each lot. They were of September and October farrow, and the feed was equal parts of corn meal and shorts for the greater part of the experiment. For a time hominy meal was substituted for the corn meal. They were fed as follows: Lot I, dry feed; Lot II, feed mixed with twice its weight of water; Lot III, feed mixed with three times its weight of water. Each lot was given all the water that was desired in addition to that contained in the feed; records were kept of all water drank. Salt and ashes were accessible. Health was good during the entire experiment. The following table shows the results:

Effect of water content of slop fed to pigs.

Ration.	Number of pigs.	Average weight beginning.	Total gain.	Average daily gain.	Feed per 100 pounds gain.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Meal (dry)	4	60	634	1.08	359
Meal 1, water 1	4	59	645	1.10	380
Meal 1, water 2	4	60	651	1.10	374
Meal 1, water 3	4	60	614	1.05	375

Aside from the apparent advantage in favor of dry feeding, at least in this experiment, the water content seems to have very little influ-

[a] Bul. No. 16. [b] Bul. No. 86, Indiana Expt. Sta.

ence on the gains when both rate of gain and feed per 100 pounds of grain are considered.

FERMENTED AND UNFERMENTED BRAN.

Burkett,[a] in New Hampshire, fed two lots (3 in each lot) of Berkshire-Chester White pigs for ninety-nine days in order to compare the effect of fermented bran in a pig's ration. Lot I received fermented bran and skim milk; Lot II received unfermented bran and skim milk. The bran was steamed in a barrel and left for ten days before it was used. The results follow:

Feeding fermented and unfermented bran to pigs.

Ration.	Number of pigs.	Average weight beginning.	Total gain.	Average daily gain.	Feed per 100 pounds gain.	
					Grain.	Milk.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Fermented bran	3	47	181	0.61	291	906
Unfermented bran	3	48	208	.70	322	923

It is said to be the practice of some New Hampshire farmers to allow bran to ferment before it is fed to pigs, and this experiment was conducted in order to test the value of this practice. The pigs on fermented bran seem to have an advantage in the economy of gain, but their gains were smaller.

WIDE AND NARROW RATIONS.

The Wisconsin Station[b] recently reported four experiments, the object of which was to compare the feeding value of wide and narrow rations. The first compared a ration of equal parts of corn meal and skim milk with one of equal parts of ground pease and wheat middlings plus an equal weight of skim milk. The pigs were Poland Chinas and Large Yorkshires, both breeds being represented in each lot. Each lot had a pen 12 feet square, having a clay floor, and opening into a yard of the same size. Salt and wood ashes were often given.

The second experiment[c] compared a ration of equal parts of corn meal and ground rye with one composed of one-third ground pease and two-thirds wheat shorts. The meal was mixed with water just before feeding and formed a thin slop. The pigs had access to coal ashes and salt, and by subdividing the feeding pens at meal time each pig was fed separately. A pen 12 feet square, with clay floor, and opening into a small yard was allowed each lot. There were 10

[a] Bul. No. 66, New Hampshire Expt. Sta.
[b] Seventeenth An. Rpt.
[c] Eighteenth An. Rpt., Wisconsin Expt. Sta.

pigs—2 Berkshires, 2 Poland Chinas, 2 Yorkshires, and 4 crossbred "razorback" Poland Chinas. These crosses were by an Indian Territory native boar (the typical razorback of the South), out of a "fine-boned, short-bodied Poland China sow." The lots were as equal as possible as regarded size, age, condition, and breed.

In the third experiment[a] pea meal and corn meal were compared. The pigs used were Yorkshires, Berkshires, razorbacks, and crosses of the razorback with Berkshires and Poland Chinas. They were divided into lots as nearly equal in all respects as possible, and were confined in a similar manner to those in the preceding experiment.

The fourth experiment[b] also compared ground pease and corn meal. The pigs were Berkshires, Poland Chinas, razorbacks, and crosses of these lard type breeds with razorbacks. The grain was made into a slop just before feeding time and the pigs were confined in a similar manner to those in the preceding experiment. Each pig had wood ashes and salt and a plentiful supply of water.

The following table shows some of the results of these experiments:

Feeding pigs on wide and narrow rations.

Ration.	Total gain per head.	Average daily gain.	Average daily amount grain eaten.	Feed per 100 pounds gain.	Digestible protein in 100 pounds feed.
Wide ration:	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Corn meal and skim milk	158.76	1.26	3.92	632	3.35
Corn and rye meals	80.8	.96	5.3	552	8.9
Corn meal	117.7	.63	3.07	491	7.9
Corn meal	130.8	.62	3.28	606	7.0
Narrow ration:					
Pease, middlings, and skim milk	147.75	1.17	3.94	681	8.85
Pease and shorts	48.4	.62	4.68	762	13.7
Pease	143.1	.75	3.96	452	16.8
Pease	140.6	.84	4.14	495	16.8

Ration.	Digestible carbohydrates in 100 pounds feed.	Digestible fat in 100 pounds feed.	Digestible protein for 100 pounds gain.	Digestible carbohydrates for 100 pounds gain.	Digestible fat for 100 pounds gain.	Nutritive ratio.
Wide ration:	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Corn meal and skim milk	35.85	2.3	33.84	228.41	14.33	1:7.7
Corn and rye meals	67.1	2.7	49.13	370.39	14.90	1:8.2
Corn meal	66.7	4.3	38.789	327.497	21.113	1:9.75
Corn meal	66.7	4.3	47.874	404.202	26.058	1:9.75
Narrow ration:						
Pease, middlings, and skim milk	28.8	1.18	60.14	196.59	8.05	1:3.6
Pease and shorts	50.6	2.7	104.39	385.57	20.57	1:4.1
Pease	51.8	.7	75.936	234.136	3.164	1:3.18
Pease	51.8	.7	83.16	256.41	3.465	1:3.18

[a] Eighteenth An. Rpt., Wisconsin Expt. Sta.

[b] Nineteenth An. Rpt., Wisconsin Expt. Sta.

During the last two years of the pig-feeding experiments where the comparison of breeds was studied, the Iowa Station[a] fed two lots of similarly bred Duroc Jersey pigs to compare wide and narrow rations. The following table shows the results at this station:

Feeding pigs on wide and narrow rations.

Ration.	Number of pigs.	Average weight beginning.	Total gain.	Number of days fed.	Average daily gain.
		Pounds.	*Pounds.*		*Pounds.*
Wide:					
First experiment	5	38	1,056	153	1.38
Second experiment	5	22	805	163	.98
Narrow:					
First experiment	5	35	967	153	1.28
Second experiment	5	22	746	163	.92

Ration.	Digestible dry matter per 100 pounds gain.	Cost of feed per 100 pounds gain.	Selling price per 100 pounds.	Dressed weight.	Nutritive ratio.
	Pounds.	*Dollars.*	*Dollars.*	*Per cent.*	
Wide:					
First experiment	319	1.84	3.70	79.3	1:7.8
Second experiment	448	2.23	3.55	77	1:7.7
Narrow:					
First experiment	328	1.93	3.70	77.1	1:4.1
Second experiment	487	2.68	3.55	74.1	1:4.9

The most striking feature of these results is the advantageous showing of the pigs on the wide rations. In the Wisconsin tests those pigs on corn meal and skim milk made larger, more rapid, and more economical gains than those on pease, middlings, and skim milk, and the same was true of those on corn meal and rye compared with pease and shorts. The rations were not excessively unbalanced in either case, the wide ones being 1:7.7 and 1:8.2 and the narrow ones 1:4.1 and 1:3.6. In both Iowa experiments there is a decided advantage in favor of the pigs receiving the wide rations. They made the largest and most rapid gains, fed more economically, both in feed eaten and money cost of feed, but sold at the same price on the market. The third and fourth Wisconsin experiments gave better returns for pease alone (a narrow ration) than for corn alone (a decidedly wide ration). These tests show, pound for pound, a greater value for pease than for corn, but it is suggested that, considering market prices of feed, corn is the cheaper. The better appetite of the pease-fed pigs was remarked upon in both tests, but especially in the last one. Some investigators have not found pease to be successful when fed alone. Day[b] states that at Guelph pea feeding resulted in poor gains and unthrifty animals, but feeding a mixture of 3 parts pea meal and 1 part middlings gave good gains and produced excellent bacon.

[a] Bul. No. 48, Iowa Expt. Sta.

[b] An. Rpt. 1899, Ontario Agr. Coll.

The effect of the narrow rations on the external appearance of the pigs was noted in the Wisconsin experiments.[a] Toward the end of the experiment, when pea meal and shorts were compared with corn meal and rye meal, the luxuriant hair and smoother flesh of the pea-fed pigs were remarked upon. The corn-fed pigs were less smooth, had deeper wrinkles, and the flesh showed a tendency to be soft and roll over the shoulders and flanks.

LIMITED COMPARED WITH UNLIMITED RATIONS.

The utility of feeding hogs on a ration which contains a quantity somewhat less than they might consume if the opportunity were afforded has been studied from two standpoints.

THE VALUE OF A SLIGHTLY REDUCED RATION.

Recognizing the necessity, under Canadian conditions, of producing a finished pig of 175 to 190 pounds weight, with a thickness of fat on the back not to exceed 1½ to 2 inches, Grisdale[b] fed three lots of pigs to determine the effect of a slight reduction of the feed. Those of one lot had all the grain they would eat up clean, and the others received somewhat less than this amount. The ration of the one lot was about 4¼ pounds of mixed grain and about 3½ pounds of skim milk daily, and that of the others was about 4 pounds of mixed grain and the same amount of skim milk daily. The following table is submitted as a tentative study of the subject:

Effect of a slight reduction in the ration of pigs.

Ration.	Number of pigs.	Average weight at beginning.	Average weight at close.	Average net gain.	Number of days fed.	Average daily gain.	Average amount feed eaten.	Average amount feed per 100 pounds gain.
		Pounds.	*Pounds.*	*Pounds.*		*Pounds.*	*Pounds.*	*Pounds.*
Oats, pease, barley, whole; amount limited	4	103	185	82	76	1.08	307	380
Skim milk, limited							254	310
Oats, pease, barley, ground; amount limited	4	101	190	89	76	1.17	307	363
Skim milk, limited							254	286
Oats, pease, barley, ½ ground, ½ whole; amount unlimited	4	103	188	85	76	1.11	326	384
Skim milk, limited							254	299

Although the statement is made that these results are not to be regarded as conclusive, this table affords material for interesting

[a] Seventeenth An. Rpt., p. 18.
[b] Bul. No. 33, Central Expt. Farm.

study. The limited ration lots made better net gains, better daily gains, and pork at a less cost of feed per 100 pounds gain than the unlimited ration lot. The influence of the ground feed on the second lot had, of course, the effect of causing a better showing over the first lot, but this influence of ground feed is not so apparent in the last test.

FEEDING WITH A GREATLY REDUCED RATION.

In Utah, Foster and Merrill made exhaustive studies of the utility of a scanty ration as compared with an unlimited one, and also the value of a period of partial starvation followed by one of unlimited feeding. This is obviously a decidedly different problem from that of the Canadian station. It is held by some feeders that pigs do better on scanty feed than on a liberal supply, and it is also held that when a period of insufficient nourishment is followed by one of full feeding the great gains made on full feed more than compensate for the loss while on the light ration.

The Utah results show the effects of partial-grain rations as compared with full-grain rations during five years while pigs were on pasture; also two years' work showing the effect of full feeding following partial feeding, the pigs having pasture during both tests, and also the effect of full feeding following pasture alone.

The usual plan was to feed one lot of pigs all the grain they would eat without waste; this was known as a "full-grain ration." The "three-fourths ration," "one-half ration," and "one-fourth ration" were computed from the full ration as a standard. These large reductions put the Utah results on a different basis from those of the Canada station.

Effects of partial-grain rations with pasture.—The following table shows the results of the five years' work with pigs receiving full and partial grain rations on pasture:[a]

Feeding pigs on full rations and greatly reduced rations.

Ration.	Total gain.	Average daily gain.	Grain eaten daily.	Grain per 100 pounds gain.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Full-grain ration	299	1.21	4.56	374
Three-fourths ration	248	1.01	3.64	354
One-half ration	186	.75	2.83	302
One-fourth ration	119	.55	1.35	247

Following a limited ration with full feeding.—Foster and Merrill[a] studied the after effects of partial grain rations by placing pigs on full and partial grain rations for a time, and following this period with one in which all the lots had a full ration.

[a] Bul. No. 70, Utah Expt. Sta.

There were 6 pigs in each lot; they were purebred and high-grade Berkshires, with a few purebred Poland Chinas; were fourteen weeks old when the experiment began, and had run on pasture with their dams. During the experiment they had the run of a good alfalfa pasture. The grain fed was chopped wheat and bran, equal parts by weight.

Lot I received all the grain they would eat.

Lot II received three-fourths as much grain as Lot I.

Lot III received one-half as much grain as Lot I.

Lot IV received one-fourth as much grain as Lot I.

The second period began immediately at the close of the first and ontinued six weeks. During this period the grain ration was unchanged; the pigs still had the run of pasture, but all the lots received as much grain as they would eat—that is, a full ration.

The following table gives a comparative statement of results for he entire experiment:

Following a limited ration with full feeding.

Ration.	Number of pigs.	Total weight at beginning.	Average daily gain.	Average amount grain eaten daily.	Total feed eaten.	Grain eaten per 100 pounds gain.	Cost per 100 pounds gain.	Profit by periods.	Total profit.
Lot I:		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Dolls.*	*Dolls.*	*Dolls.*
First period, full grain ration	6	259	1.18	3.92	1,697	333	2.08	9.77	12.81
Second period, full grain ration	6	786	1.25	6.21	1,697	496	3.10	3.04	
Lot II:									
First period, ¾ grain ration	6	259	.914	2.94	1,273	322	2.01	7.86	11.79
Second period, full grain ration	6	654	1.23	5.58	1,507	452	2.82	3.93	
Lot III:									
First period, ½ grain ration	6	260	.685	1.96	849	286	1.79	6.54	10.38
Second period, full grain ration	6	556	1.19	5.31	1,436	448	2.80	3.84	
Lot IV:									
First period, ¼ grain ration	6	250	.386	.975	424	254	1.59	4.03	8.19
Second period, full grain ration	6	417	1.12	4.74	1,281	421	2.63	4.16	

It will be seen that during the entire experiment the average daily gain varied with the amount of grain received during the first period; the lots receiving the smallest rations during the first period made the cheapest gains, but the advantage in the total profits is with Lot I.

Full rations after pasture.—The effect of a period of full feeding following one of scanty nourishment is strikingly shown in the Utah results[a] with pigs that went through tests on pasture alone. In 1898

[a] Bul. No. 70, Utah Expt. Sta.

one lot of pigs was on a mixed pasture on which were also some cattle and sheep. A second lot was on alfalfa pasture. No grain was given in either case. The lot on mixed pasture made slight gains. Those on alfalfa changed greatly in appearance during the experiment and lost in weight. At the close of the pasture test the pigs were placed in a pen and fed a full ration of grain and dairy by-products. This second period lasted eight weeks.

In 1899 a similar experiment[a] was conducted, the pigs being on alfalfa pasture. Both lots lost in weight. At the close of the pasture test they were placed in pens and fed all the grain they would eat up clean, having the run of the pasture during feeding times. This period lasted forty-four days. One pig in Lot II failed to thrive and died after the experiment closed. "Postmortem examination showed dry undigested food in the intestines, also the intestines much inflamed."

The following table shows the results of these tests:

Feeding pigs on full grain rations following pasture.

Data.	1898.	1899.	
	Lots I and II.	Lot I.	Lot II.
Total weight at beginning ..... pounds..	601	172	290
Total weight at close ..... do....	1,310	358	486
Total gain ..... do....	709	186	187
Days fed ..... number..	56	44	44
Average daily gain ..... pounds..	2.11	1.41	1.42
Total feed eaten:			
Milk ..... do....	4,101		
Whey ..... do....	2,751	[a]673	[a]862
Grain ..... do....	2,387		
Average amount of feed eaten daily:			
Milk ..... do....	12.20		
Whey ..... do....	8.19	[a]5.1	[a]6.53
Grain ..... do....	7.10		
Feed per 100 pounds gain:			
Milk ..... do....	578		
Whey ..... do....	388	[a]363	[a]461
Grain ..... do....	337		
Cost per 100 pounds gain:			
Milk ..... dollars..	.87		
Whey ..... do....	.27	2.26	2.89
Grain ..... do....	2.11		

[a] Grain only.

These experiments seem to point to two conclusions. In the Canadian results a carefully conducted experiment apparently confirms what has frequently been urged by writers on the feeding of both men and the lower animals, namely, that the digestive system will be kept in better tone and will thus be able to do better work if it is not

[a] See pp. 151, 152 for a detailed abstract of these pasture periods.

crowded to the limit. The great forcing to which animals are subjected during the fattening process must surely have an effect that is similar to that of high living in man, namely, a derangement of the digestive and circulatory organs; and it is beginning to be questioned whether this process of compelling a pig or a steer or a sheep to eat up to his limit twice or three times a day for several months is economical. The pigs on a limited ration in the Canadian experiment received an average daily amount of grain of only about one-half pound less than those that were eating all they would clean up, and ate in seventy-six days a total of only 19 pounds less grain. Yet in one case the average daily gain was better, and in both the gains were made more economically—384 pounds grain and 299 pounds milk being required for 100 pounds gain with the unlimited ration lot, while 343 pounds grain and 285 pounds milk and 360 pounds grain and 309 pounds milk, respectively, were required for 100 pounds gain with the two lots on the limited ration. This would seem to be a subject worthy of further investigation.

The Utah results are decidedly against the system of starving animals at any period of their growth. While the economy of the cramming method of feeding may merely be questioned, no one can doubt that the best results in the fattening of animals will come when they are kept gaining up to the close of the feeding period. These experiments were conducted to test the soundness of the claim made by some feeders that the loss due to feeding and extremely light grain rations is more than made up by the large gains made when the animal is given all the grain it will eat, and that a period spent on pasture with little or no grain feeding distends the stomach of hogs by filling them with a mass of bulky feed, and so prepares them to assimilate feed more readily when placed on a full grain ration, to eat more feed, and consequently to make larger and more economical gains. Practically, they were designed to study the utility of a maintenance ration. In the experiment to study the effect of feeding partial grain rations followed by full feeding (pp. 93, 94), the pigs on a full grain ration during both periods made the greatest gains through the entire experiment; but the feed per 100 pounds gain and the money cost per 100 pounds gain varied directly with the amount of the daily ration, the pigs receiving the smallest amount making the cheapest gains. However, the profits on the feeding were greatest with those pigs that were not stinted in their feed, except in the second period, when the pigs that had been on partial rations showed the largest profits. The economy of feeding during the early months of a pig's life is thus exemplified. With the pigs that were on pasture alone, the same is true; a summer of stagnation was counterbalanced by a short period of heavy feeding, enormous eating, and very large gains that nevertheless were not sufficient to make the entire feeding process economical.

CORN AND CORN SUBSTITUTES.

To the farmer of the corn belt those experiments with grains which may take the place of corn for feeding purposes in times of scarcity are always interesting. In seasons such as that of 1901, when a summer of extreme heat and little or no rain follows a spring of normal conditions, the short corn crop is frequently counterbalanced by a bountiful supply of small grains. Many farmers at such times rely on wheat, barley, oats, and rye to carry their stock to marketable condition. Outside the corn-growing districts such experiments are of even more importance, for the small grains are often grown in great abundance and form the basis of all rations.

Wheat compared with corn.—At the Indiana Station[a] Plumb and Anderson fed four lots of 4 Chester White pigs to study the relative value of feeding wheat and corn, both alone and in combination. The pigs were farrowed late in October, and the experiments began as soon as they were weaned, which was early in January. They were out of two sows that were litter sisters. Lot I received whole corn; Lot II received dry whole wheat; Lot III received a ration consisting of equal parts of corn and wheat; Lot IV received soaked whole wheat.

Up to March 6 they received 10 pounds of separator milk as a noon feed and after that date 12 pounds of the same daily. They were fed one hundred and five days. The results were as follows:

Wheat compared with corn for pigs.

Lot.	Ration.	Number of pigs.	Weight at beginning.	Weight at close.	Number of days fed.	Average daily gain.	Feed per 100 pounds gain.[a]
			Pounds.	*Pounds.*		*Pounds.*	*Pounds.*
I	Corn	4	185	673	105	1.16	312
II	Wheat (dry)	4	175	607	105	1.02	355
III	Corn and wheat, equal parts	4	174	646	105	1.12	323
IV	Wheat (soaked)	4	189	633	105	1.05	355

[a] Digestible dry matter.

At the Utah Station, Foster and Merrill[b] conducted similar work in comparing ground wheat with corn meal. Two lots of 3 pigs each were fed, in covered pens, all the ground grain they would eat. The results follow:

Ground wheat compared with corn meal for pigs.

Ration.	Number of pigs.	Weight at beginning.	Weight at close.	Number of days fed.	Average daily gain.	Feed per 100 pounds gain.
		Pounds.	*Pounds.*		*Pounds.*	*Pounds.*
Corn meal	3	290	519	91	0.85	558
Ground wheat	3	291	615	91	1.20	464

[a] Bul. No. 67. [b] Bul. No. 70.

At the usual price of corn and wheat, 75 cents per hundredweight, the cost of gain for the corn-fed lot is given as $4.18 per 100 pounds, and that of the wheat-fed lot at $3.48 per 100 pounds.

At the close of this test a second one was made, but the ration of the first lot was made equal parts of corn meal and pea meal after the middle of the test. The results follow:

Ground wheat compared with corn and pea meals for pigs.

Ration.	Number of pigs.	Weight at beginning.	Weight at close.	Number of days fed.	Average daily gain.	Pounds feed per 100 pounds gain.
		Pounds.	*Pounds.*		*Pounds.*	*Pounds.*
Corn and pea meals	3	260	670	115	1.12	407
Ground wheat	3	257	587	115	.96	468

Wheat compared with various other grains.—At the Nebraska Station, Smith[a] fed eight lots of 6 pigs each to study the comparative feeding value of wheat, rye, and corn, both alone and in combination. Charcoal and lime were fed occasionally. Four pigs in each lot were of the bacon type—Tamworth and Yorkshire—and two were of the fat, or lard, type, or "block" type, as the author expresses it. Each lot had an 8 by 12 foot cement-floored pen in a closed shed, with an 8 by 16 foot yard adjoining. The ground feed was mixed into a thick slop after being weighed; the soaked wheat was weighed before being soaked. The first cost of the pigs was $4.50 per 100 pounds and they were sold on the farm at $5.52½ per 100 pounds. Corn and wheat were charged at 55 cents per bushel, rye at 50 cents per bushel, and shorts at $18 per ton. Grinding was charged at 8 cents per 100 pounds for wheat and rye and 6 cents per 100 pounds for corn. A statement of the results follows:

Wheat compared with other grains for pigs.

Ration.	Number of pigs.	Average weight at beginning.	Average weight at close.	Total gain.	Number of days fed.	Average daily gain.	Total feed eaten.	Feed per 100 pounds gain.	Profit per lot.
		Lbs.	*Lbs.*	*Lbs.*		*Lbs.*	*Lbs.*	*Lbs.*	*Dolls.*
Whole wheat, dry	6	110	167.0	342	91	0.63	2,178	637	5.72
Whole wheat, soaked 18 to 24 hours	6	110	174.0	385	91	.70	2,210	575	7.81
Ground wheat	6	108	177.0	414	91	.76	2,317	559	6.43
Ground wheat and corn, equal parts	6	111	178.0	401	91	.74	2,351	586	6.05
Ground wheat and rye, equal parts	6	107	170.7	383	91	.70	2,376	621	4.34
Ground wheat and shorts, equal parts	6	109	174.0	388	91	.71	2,375	612	5.65
Ground corn	6	110	174.5	387	91	.71	2,356	609	3.60
Ground rye	6	107	168.0	367	91	.67	2,290	624	4.55

[a] Bul. No. 75.

In this experiment ground wheat gave the greatest returns for the least amount of grain, but did not return so large a profit as whole soaked wheat, owing to the expense of grinding. The undesirability of feeding whole wheat dry seems to be indicated by these results. Ground wheat and corn gave considerably better returns than ground wheat and rye or ground wheat and shorts. Ground corn and rye alone do not appear to advantage.

These results show wheat to have a feeding value fully equal to that of corn, and are in line with the work that has been previously published on this subject. In the first Utah test, wheat showed a very much better and cheaper gain than corn, but when pea meal was added to the corn-meal ration, wheat did not have so great an advantage. The Nebraska results are specially favorable to wheat feeding.

Feeding frosted wheat.—Nine experiments with wheat that had been more or less damaged by frost were conducted at the Central Experimental Farm of Canada.[a] The grain was fed alone, ground, unground, and in combination with other grains and skim milk.

The following shows the results and conclusions from the experiments:

Frosted wheat for pigs.

Experiment.	Ration.	How prepared.	Number of pigs.	Average weight at beginning.	Average weight at close.	Average net gain.	Number of days fed.	Average daily gain.	Average amount feed eaten.	Feed per 100 pounds gain.
				Lbs.	*Lbs.*	*Lbs.*		*Lbs.*	*Lbs.*	*Lbs.*
1	Wheat	Ground, soaked 12 hours.	4	185	275	90	77	1.17	479	530
2	do	Whole, soaked 42 hours.	4	186	273	86	77	1.11	570	659
3	Wheat, barley, and pease.	do	4	187	278	92	77	1.19	557	607
4	Wheat	Ground, soaked 12 hours.	5	61	165	104	120	.87	441	423
5	do	do	4	104	192	88	56	1.57	233	265
	Skim milk								1,011	1,251
6	Wheat	Ground, soaked 18 hours.	12	103	187	84	84	1.00	442	526
7	Wheat and barley	Ground, soaked 30 hours.	21	117	179	62	84	.73	326	445
	Carrots								53	85
8	Barley, wheat, rye, and bran.	Ground, soaked 12 hours.	36	54	108	54	105	.51	207	385
9	Barley, rye, wheat, and bran.	do	31	108	191	83	83	1.00	268	323
	Skim milk								250	300

[a] Bul. No. 33.

The fact that this wheat had been injured by frost does not seem to have had a serious effect on its feeding value. In the majority of instances the gains made were satisfactory, and those cases in which a large amount of grain was required for 100 pounds of gain were generally with hogs of considerable maturity and consequently expensive feeders.

Barley compared with corn.—The following results were obtained with barley alone in comparison with corn alone in South Dakota, Colorado, and Canada:

Barley compared with corn for pigs.

Ration.	Number of tests.	Number of pigs.	Average weight at beginning.	Total gain.	Number of days fed.	Average daily gain.	Feed per 100 pounds gain.		
							Corn.	Barley.	Milk.
Colorado:[a]			*Lbs.*	*Lbs.*		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
Whole corn	6		71			0.39	700		[e]110
Ground corn	5		60			.46	540		[e]110
Whole bald barley	8		88			.58		500	[e]130
Ground bald barley	5		67			.74		360	[e]80
Whole common barley	4		68			.49		540	[e]70
Ground common barley	4		47			.70		430	[e]110
South Dakota:[b]									
Corn meal	1	5	126	430	56	1.53	453		
Barley	2	9	112	803	56	1.59		457	
Ontario Agricultural College:[c]									
Corn						.70	547		
Barley						1.17		456	
Central Experimental Farm, Ottawa:[d]									
Whole corn	1	3	72	354	91	1.30	290		231
Ground corn	1	4	74	392	112	.87	416		
Whole barley	1	4	99	400	84	1.19		364	252
Ground barley	1	4	73	444	112	1.00		435	

[a] Bul. No. 40.
[b] Bul. No. 63.
[c] An. Rpts., 1899 and 1900.
[d] Bul. No. 33.
[e] Quarts.

This table does not present an accurate comparison between barley and corn, as skim milk enters into the results in five instances when barley was fed, as against only three instances where corn was fed, but the results command interest in showing that the value of barley for hog feeding compares very favorably with that of corn.

Barley compared with corn, in combinations.—The South Dakota Experiment Station and the Ontario Agricultural College have reported tests with barley in combination with such feeds as shorts and middlings.

[End of Part I.]

The following table shows the results:

Barley compared with corn, with shorts or middlings for pigs.

Ration.	Number of tests.	Number of pigs.	Average weight at beginning.	Total gain.	Number of days fed.	Average daily gain.	Feed per 100 pounds gain.	
							Corn.	Barley.
South Dakota: [a]			*Lbs.*	*Lbs.*		*Lbs.*	*Lbs.*	*Lbs.*
Corn and shorts equal parts	2	9	111	840	56	1.67	413	.....
Barley and shorts equal parts	4	17	115	1,561	56	1.64	.....	456
Ontario Agricultural College: [b]								
Corn and middlings	1	11	63	.....	.....	.79	480	.....
Do	1	12	.....	.....	140	.817	432	.....
Do	1	5	55	664	.....	.677	[c]424.55	.....
Barley and middlings.	1	13	63	.....	.....	.80	.....	490
Do	1	12	.....	.....	140	.841	.....	450
Do	1	4	42	501	.....	.639	.....	[c]439.22

[a] Bul. No. 63. [b] An. Rpts., 1899 and 1900. [c] Dry matter.

These results are not so favorable to barley as those of the preceding table, but it can also be said, in the light of these figures, that barley is nearly if not quite equal to corn for feeding pigs, judging it solely from the standpoint of rate and economy of gain, and if we take into consideration its effect on the carcass, it far surpasses corn as a high-grade pig feed. An experiment with purebred hogs at the Ontario Agricultural College, which is not included in the foregoing table, compared barley and corn. Some middlings and skim milk were given, but during the last month the grains were fed alone. While receiving middlings and skim milk the pigs on corn made the most economical gains, but after the middlings and skim milk were withdrawn the pigs on barley made the most rapid and economical gains. The experience of this institution places barley at the head of the list of American bacon-producing feeds.

Ground wheat and barley compared with shelled corn.—At the Colorado Station Buffum and Griffith[a] fed two lots of pigs to compare the feeding value of home-grown Colorado grains with corn, which must be imported from States further east. The pigs used were rather ordinary grade Poland Chinas and Berkshires, about eight months old at the beginning of the experiment. One lot was fed shelled corn; the other, a mixture of equal parts of ground wheat and barley. The wheat and barley were grown on the college farm. "The wheat was the common Defiance variety and was grown in a field producing 34 bushels per acre. The barley was of the common hulled variety and was grown in a field that produced 25 bushels per acre."

The pigs were kept in pens of equal size, each pen with a yard

[a] Bul. No. 74.

adjoining. The pens were well bedded with straw. Water was given in abundance and occasionally coal and ashes. The following table shows the results:

Ground wheat and barley compared with shelled corn for pigs.

Ration.	Number of pigs.	Average weight at beginning.	Average gain.	Number of days fed.	Average daily gain.	Average amount of feed eaten.		Feed per 100 pounds gain.		Cost per 100 pounds gain.	Profit at 7 cents per pound.
						Corn.	Wheat and barley.	Corn.	Wheat and barley.		
		Lbs.	*Lbs.*		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Dols.*	*Dols.*
Corn	4	95	71.25	101	0.70	383.50	.....	540	.....	7.00	0.95
Wheat and barley	4	94.5	120.25	104	1.16	.....	546.50	.....	450	4.50	3.90

This experiment shows a mixture of wheat and barley to be much more valuable than corn alone for pig feeding. It also speaks very well for the econony of pork production in those States where corn is not a staple crop. Buffum and Griffith state that it is a common practice in the neighborhood of Fort Collins for farmers to exchange barley or wheat for corn on even terms, and even when corn is high in price and wheat and barley cheaper, they will sell the cheaper home-grown grains and buy the expensive one. They give the average price for ten years of these grains in Colorado as 80.5 cents per 100 pounds for corn, 99.5 cents per 100 pounds for wheat, and 55.1 cents per 100 pounds for barley. They ask, very pertinently, whether Colorado feeders have not the solution of the problem of a supply of concentrates for pork production when home-grown grains sell on the farm for less money per 100 pounds than corn can be purchased in town, and especially when either wheat or barley is equal to corn for this purpose and in combination are superior to it.

Oats compared with corn.—Grisdale[a] reports a comparison of oats and corn. The grain was fed whole and was soaked fifty-four hours before feeding. Both lots received skim milk in addition. The results were as follows:

Oats compared with corn for pigs.

Pation.	Number of pigs.	Average weight at beginning.	Average weight at close.	Average gain.	Number of days fed.	Average daily gain.	Feed per 100 pounds gain.	
							Grain.	Milk.
		Pounds.	*Pounds.*	*Pounds.*		*Pounds.*	*Pounds.*	*Pounds.*
Oats	4	97	170	73	84	0.87	421	345
Corn	3	72	190	118	91	1.30	290	23

[a] Bul. No. 33, Central Expt. Farm.

The results of this test are not very favorable to oats as a pig feed. To get even as economical a gain as could be had from corn a feeder would have to get nearly twice as good gains as from the oats; for, pound for pound of nutrient material, oats is about twice as expensive as corn.

Corn and Kafir corn.—The Oklahoma Station[a] compared Indian corn and Kafir corn as follows:

Six pigs, averaging about 135 pounds at the beginning of the test, were fed six weeks on Kafir heads, and made an average daily gain of 1.11 pounds, requiring about 665 pounds of grain for 100 pounds of gain.

Three pigs, averaging 220 pounds at the beginning, made an average daily gain of 1.53 pounds for thirty-five days, and required the equivalent of 494 pounds of shelled corn for 100 pounds of gain. These same pigs were then fed Kafir meal for two weeks and made 1 pound of gain per head daily, eating 921 pounds of meal for each 100 pounds of gain.

Four pigs, averaging 105 pounds, were fed thirty-five days on Kafir meal. They made an average daily gain of 1.21 pounds, eating 508 pounds of meal for 100 pounds of gain. For the next two weeks they were given soaked shelled corn. They made a total gain of only 30 pounds, eating 707 pounds of corn for 100 pounds of gain. For the next four weeks a daily supply of green alfalfa was given with good effect. A total gain of 140 pounds was made, requiring 365 pounds of grain for 100 pounds of gain.

Kafir corn.—The value of Kafir corn for hogs has been studied extensively at the Kansas Station. Kafir corn was found to have a feeding value considerably below that of corn when both grains were fed alone. In Bulletin No. 95, Cottrell states that the average of a number of trials shows that 527 pounds of Kafir corn and 468 pounds of Indian corn, respectively, are required per 100 pounds of pork made; the yield of pork per bushel of grain being 10.6 pounds in case of Kafir corn and 11.9 pounds with Indian corn. On upland soil, however, the average of eleven years on the Kansas Agricultural College farm shows returns of 46 bushels per acre for Kafir corn and 34½ bushels for Indian corn. Such returns, with gains as noted above, indicate a pork yield per acre of grain at 487 pounds for Kafir corn and 410 pounds for Indian corn. The great value of Kafir corn is its ability to resist drouth.

Soy beans in a Kafir corn ration.—In addition to the lighter returns from Kafir corn than from Indian corn, this grain is very constipating when fed alone, and hogs, especially young ones, tire of it sooner than they do of Indian corn. To remedy these difficulties a mixture

[a] An. Rpt., 1898–99.

is advised, especially with feeds of a laxative nature. One of the most convenient nitrogenous concentrates at the hands of the Kansas farmer is the soy bean. In a series of experiments[a] the effect of such an addition to both Indian corn and Kafir corn rations was studied. The following summary of five experiments shows that soy beans increase gains and diminish the amount of feed required for 100 pounds gain:

Effect of soy beans in a Kafir corn ration for pigs.

Ration.	Average gain.	Increased gain from soy beans.	Feed per 100 pounds gain.	Feed saved by feeding soy beans.
First experiment:	*Pounds.*	*Pounds.*	*Pounds.*	*Per cent.*
Kafir corn meal	90.6		471	
Kafir corn meal ½ Soy bean meal ½	103.8	14.6	409	13.2
Second experiment:				
Kafir corn meal	102.0		559	
Kafir corn meal ½ Soy bean meal ½	145.7	42.8	408	27.0
Third experiment:				
Kafir corn meal	74.2		542	
Kafir corn meal ½ Soy bean meal ½	129.2	74.1	374	31.0
Corn meal	82.6		484	
Corn meal ½ Soy bean meal ½	120.4	45.5	369	23.7
Fourth experiment:				
Kafir corn meal	52.4		749	
Kafir corn meal ½ Soy bean meal ½	97.8	86.5	468	37.5
Fifth experiment:				
Kafir corn meal	44.1		653	
Kafir corn meal ½ Soy bean meal ½	86.6	96.4	435	33.2

The effect of feeding soy beans is good. Hogs receiving them "fatten rapidly, look thrifty, have strong appetites, and the hair and skin are glossy, like those of animals fed oil meal."

The following summary gives a more elaborate comparison of the relative values of Kafir corn or Indian corn meal alone and in combination with soy beans.[a] The results are arranged in order of economy of gains, the total showing the number of pounds of feed required for 100 pounds of gain.

[a] Bul. No. 95, Kansas Expt. Sta.

Value of soy beans in a Kafir corn or Indian corn ration.

Ration.	Feed per 100 pounds gain.	Ration.	Feed per 100 pounds gain.
	Pounds.		*Pounds.*
Corn meal ⅞, soy bean meal ⅛	369	Kafir corn meal, soaked forty-eight hours	542
Kafir corn meal ⅞, soy bean meal ⅛	374	Kafir corn, whole, soaked forty-eight hours	550
Kafir corn meal ¾, soy bean meal ¼	408	Kafir corn meal, wet	559
Kafir corn meal ⅔, soy bean meal ⅓	409	Kafir corn, whole, soaked forty-eight hours	632
Kafir corn meal ⅝, soy bean meal ⅜	435	Kafir corn, whole, wet	638
Kafir corn meal ½, corn meal ½	456	Kafir corn, whole, wet	640
Shelled corn, dry	457	Kafir corn meal, wet	653
Kafir corn meal ½, soy bean meal ½	468	Kafir corn, whole, dry	655
Kafir corn meal, wet	471	Kafir corn meal, wet	691
Kafir corn meal ½, corn meal ½, wet	477	Kafir corn meal, dry	749
Shelled corn, dry	479	Average	528
Corn meal, soaked forty-eight hours	484		
Kafir corn, whole, dry	512		
Kafir corn meal and cotton-seed meal	540		
Kafir corn, whole, dry	542		

"The six lots of hogs having soy beans as part of their ration required an average of 411 pounds of grain for 100 pounds of gain, while the 19 lots not fed soy beans required an average of 564 pounds of feed for 100 pounds of gain, an increase in food required of over 37 per cent."

Pease compared with wheat.—The Utah Station[a] compared the values of pease and wheat during two years. The pigs were confined in yards and the grain was given whole and dry. The average of results was as follows:

Pease compared with wheat for pigs.

Ration.	Total weight at beginning.	Total gain.	Feed per 100 pounds gain.
	Pounds.	*Pounds.*	*Pounds.*
Pease	147	303	452
Wheat	136	282	476

Cowpeas alone compared with corn alone.—At the South Carolina Station[b] Newman and Pickett fed to compare cowpeas with corn. The pigs were from eight to eleven months old and were fed in pens. There were 3 pigs in each lot.

The cowpea-fed lot ate 6.7 pounds of cowpeas per head daily and made an average daily gain for the lot of 3.38 pounds. They required 491 pounds of cowpeas to produce 100 pounds of gain.

The corn-fed lot ate 9.2 pounds of corn per head daily and made an average daily gain for the lot of 4.17 pounds. They required 602 pounds of corn to produce 100 pounds of gain.

With pork at 5 cents per pound and corn and cowpeas yielding 15 bushels and 10 bushels, respectively, per acre, the value of an acre of corn in this experiment was $6.97 and that of an acre of cowpeas $6.12.

[a] Bul. No. 70. [b] Bul. No. 52.

Ground cowpeas and corn meal compared with corn meal.—At the Alabama Station[a] Duggar fed two lots of pigs to compare the relative value of a ration of half corn meal and half ground pease with an exclusive corn-meal ration. The pigs used were placed in covered pens, with small yards adjoining, and, after a preliminary period of a week, put into the experiment which lasted sixty days. The results are as follows:

Ground cowpeas and corn meal compared with corn meal for pigs.

Ration.	Gain.	Number of days fed.	Feed eaten.	Feed per 100 pounds gain.
	Pounds.		*Pounds.*	*Pounds.*
Ground corn alone	68	60	548	806
Corn ½, cowpeas ½	108	60	570	528

In this experiment the cowpea and corn-meal ration made gains 34 per cent more economical than corn alone. The quality of the pork made was as good as that of corn-fed pork.

Peanuts compared with corn meal.—Duggar[a] placed in pens the pigs used to compare the values of peanut pasture and corn meal (see p. 160) to make a more accurate study of the nutritive values of Spanish peanuts and corn meal. The lots received the same rations, except that the peanuts were dry and fed unhulled. The test lasted six weeks with the following results:

Peanuts compared with corn meal for pigs.

Ration.	Number of pigs.	Number of days fed.	Total gain.	Average daily gain.	Feed per 100 pounds gain.
			Pounds.	*Pound.*	*Pounds.*
Peanuts ½, corn meal ½	3	42	84	0.67	370
Peanuts only	3	42	59.5	.47	280
Corn meal only	2	42	8.6	.10	1,070

This experiment shows the best daily gains from the combination of peanuts and corn meal, and shows the best returns for feed eaten by the pigs on peanuts alone. This lot made very much better gains than the pigs fed exclusively on corn meal, which fed very poorly. The pigs on peanuts alone made a gain of 9 pounds per bushel of peanuts. "This gives a value of 27 cents to a bushel of Spanish peanuts when pork is worth 3 cents per pound gross, and 31½ cents when pork is worth 3½ cents per pound." The unthrifty appearance of the pigs fed on corn meal only was commented upon.

At the South Carolina Station, Newman and Pickett[b] fed two lots of grade Berkshire and Duroc Jersey pigs, from eight to eleven months old, in pens, to study the relative values of peanuts and corn. On land of similar character they estimated the corn yield at 15 bushels per acre and peanuts 90 bushels, and in their investigations they found that,

[a] Bul. No. 93. [b] Bul. No. 52.

with exclusive corn feeding, 602 pounds of corn were required for 100 pounds of gain and with peanuts 443 pounds for 100 pounds of gain. On this basis, an acre of corn will produce 140 pounds of pork and an acre of peanuts 488 pounds, worth, respectively, when pork is 5 cents per pound, $6.97 and $24.37.

COMMERCIAL BY-PRODUCTS.

One of the prominent features of modern industry is the development of the possibilities of the by-product—the waste and offal of manufacturing establishments. Farmers have long appreciated the value of the by-products of flour mills, but of recent years many other materials have come into the market as valuable feed for farm animals. Rice mills, oil mills, and packing houses all have their by-products, which are useful in supplementing the products of the farm.

MILLING PRODUCTS.

The by-products of the flour mills have for years been bought by farmers for use in the feed box, and one of these—middlings—has come to have an unsurpassed reputation for hog feeding, especially for young animals in the early stages of fattening. With the development of milling the ingenuity of the manufacturer has enabled him to throw a host of new foods upon the market. In consequence, we have, in the first place, a by-product more completely deprived of its nutrient material, perhaps, than formerly, but more uniform in quality; and, in the second place, a greater variety of feeds with which to supply the bins. It is not alone the products of the flour mills that have value for feeding purposes. The rice mills, glucose factories, and oil mills all have by-products that are useful adjuncts to feeding operations. Indeed, most of the experimental work of recent years deals with the value of the by-products of these industries. In the majority of instances these feeding stuffs are best used as adjuncts to corn or corn meal, although often the proximity of feed yards to a mill cheapens the by-products sufficiently to enable the feeder to use them as the main part of the ration.

Bran and corn meal compared with corn meal.—Burkett[a] fed two lots of 3 pigs each, one receiving a ration of equal parts of bran and corn meal and milk and the other corn meal and milk. The object was to compare the value of bran in such a ration and have the corn-fed lot as a check. The results follow:

Bran and corn meal compared with corn meal for pigs.

Ration.	Number of pigs.	Average weight at beginning.	Total gain.	Number of days fed.	Average daily gain.	Feed per 100 pounds gain.	
						Grain.	Milk.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Bran and corn meal	3	47.6	227	99	0.76	308	882
Corn meal	3	47	323	99	1.08	263	663

[a] Bul. No. 66, New Hampshire Expt. Sta.

This experiment gave much better returns for a corn-meal and skim milk ration than for one where bran was added. Burkett does not value bran highly as a pig feed either alone or in combination with corn meal.

Shorts compared with corn.—At the Colorado Station, Buffum and Griffith[a] fed purebred Berkshire pigs about 5 months old to compare the feeding value of corn meal and shorts in combination with wheat, barley, and oats. One lot received shorts, wheat, oats, and barley in rotation—shorts with wheat and oats one day, with wheat and barley the next, with oats and barley the next, and so on. The lot on corn had the same method of feeding and the same ration, except that corn was fed in place of shorts. Feed was charged at the following prices: Corn, 83 cents per 100 pounds; shorts, 75 cents per 100 pounds; wheat, 95 cents per 100 pounds; oats, $1.20 per 100 barley, $1.20 per 100 pounds. The experiment lasted from March 23 to May 31, 1901—sixty-nine days—the results being as follows:

Shorts compared with corn in mixed rations for pigs.

Ration.	Number of pigs.	Average weight at beginning.	Average gain.	Number of days fed.	Average daily gain.	Average amount feed eaten.			Feed per 100 pounds gain.	Cost per 100 pounds gain.
						Corn.	Shorts.	Other grain.		
		Lbs.	*Lbs.*		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	
Shorts and grain	3	112.5	88.2	69	1.31	.....	226.5	225.6	521	$4.70
Corn and other grain	3	98	85.6	69	1.27	208.6	.....	209.1	487	4.79

At the Indiana Station Plumb and Anderson[b] fed two lots of 3 high-grade Chester White gilts, each five and one-half months old, to compare the value of a ration of corn meal and wheat shorts with a ration of corn meal only. The mixture was equal parts by weight of corn meal and shorts. The pigs were fed in pens with small shelter houses attached. Shorts were valued at $14 per ton and corn meal at $13.50 per ton. The results were as follows:

Feeding value of wheat shorts.

Ration.	Number of pigs.	Average weight at beginning.	Total gain.	Number of days fed.	Average daily gain.	Total feed eaten.		Feed per 100 pounds gain.	Cost of feed per 100 pounds gain.
						Shorts.	Corn meal.		
		Pounds.	*Lbs.*		*Lbs.*	*Lbs.*	*Lbs.*	*Pounds.*	*Dollars.*
Shorts and corn meal	3	129	354	70	1.69	718	718	406	2.74
Corn meal	3	129	327	70	1.56	.....	1,413	432	2.80

The mixture of corn meal and shorts gave larger, more rapid, and more economical gains than a ration of corn meal only. In the Colo-

[a] Bul. No. 74. [b] Bul. No. 71.

rado experiments the pigs fed on a ration of shorts made larger and more rapid gains than those on corn meal, but they required more feed per 100 pounds gain.

Corn meal compared with rice meal.—The South Carolina Station[a] compared rice meal and corn meal. "The rice meal is a by-product of the rice mills and consists largely of rice flour, rice polish, and rice bran. As yet the mills have no uniform way of putting it on the market, and, in order that the reader may understand what is meant by rice meal, as used in this experiment, it may be said that it is all the by-product obtained in cleaning the rice grain for the market. Its chemical composition shows that it has about the same amount of protein, carbohydrates, and fat as corn meal."

The pigs used were Berkshires, about five months old, weighing about 90 pounds each. They were given a ration consisting of 1 part meal and 4 parts skim milk, the milk being mixed with the meal, and were confined in pens 20 by 40 feet, with plenty of shade.

The experiment was divided into two periods. During the first period of thirty-nine days Lot I was fed the corn-meal ration and Lot II the rice-meal ration; during the second period of twenty-two days the feed was reversed, Lot I having rice meal and Lot II corn meal.

The results during the first period were not decisive, but during the second they were somewhat favorable to the rice meal.

The results for each kind of grain for the entire experiment are as follows:

Rice meal compared with corn meal for pigs.

Ration.	Number of pigs.	Total gain.	Number of days fed.	Average daily gain.	Feed eaten.		Feed per 100 pounds gain.		Cost of feed per 100 pounds gain.
					Meal.	Milk.	Meal.	Milk.	
		Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Dollars.*
Rice meal 1 part, skim milk 4 parts	3	314.5	61	1.72	779	3,116	248	991	3.84
Corn meal 1 part, skim milk 4 parts	3	303	61	1.66	779	3,116	257	1,028	4.63

The corn meal was valued at $20 per ton, rice meal at $15 per ton, and skim milk at 20 cents per 100 pounds. This experiment shows that rice meal, such as was used in this test, is fully as valuable as corn meal in pig feeding and corroborates previous work along this line.

Feeding value of rice polish.—Owing to the high price of corn during 1902, Duggar[b] devoted considerable attention to the investigation of the value of those feeds whose composition seemed to indicate that

[a] Bul. No. 55. [b] Bul. No. 122, Alabama Expt. Sta.

y could be used as substitutes for corn meal in pig feeding. In connection rice polish was fed to a number of pigs under different nditions. Rice polish is a by-product of the rice mills and is difficult to obtain in some sections of the country, as millers often mix it less valuable by-products and sell the mixture under the name rice meal." For this reason rice meal is said to be a variable and ertain quantity and all samples do not have equal feeding value. 902 rice polish was quoted by a Savannah mill at $17.90 per ton, vered at Auburn, Ala., in less than carload lots. Two years before same firm had been paid $26 per ton for it delivered at Auburn. is stated that some of it kept in good condition for more than ear.

uggar reports seven tests with this by-product. He compared it corn meal with and without the addition of skim milk, and a mixed ration of cowpea meal a wheat bran; with a ration of half cowpea meal, one-fourth cor eal, and one-fourth rice bran, the addition of skim milk; an in different proportions with other feeds without skim milk. The pigs used were generally recently weaned and the meal was fed dry.

The following table summarizes the results:

Feeding value of rice polish.

Ration.	Number of pigs.	Total gain.	Number of days fed.	Average daily gain.	Feed per 100 pounds gain.		
					Grain.		Milk.
					Rice polish lots.	Other lots.	
		Lbs.		*Pounds.*	*Pounds.*	*Lbs.*	*Lbs.*
Corn meal and skim milk	3	90	35	0.86	.....	210	465
Rice polish and skim milk	3	109	35	1.04	170	.....	367
Corn meal	3	.....	.....	.....	.....	670	.....
Rice polish	3	.....	.....	.....	670	.....	.....
Corn meal	3	54	28	.64	.....	501	.....
Rice polish	3	79	28	.94	340	.....	.....
Corn meal	3	68	56	.40	.....	621	.....
Rice polish	3	132	56	.79	375	.....	.....
Corn meal 2, cowpea meal 2, wheat bran 1	3	56	28	.67	.....	370	.....
Rice polish 2, cowpea meal 2, wheat bran 1	3	66	28	.79	310	.....	.....
Cowpea meal 2, corn meal 1, rice polish 1, and skim milk	3	.....	35	.....	.....	178	413
Rice polish and skim milk	3	.....	35	.....	193	.....	474
Cowpea meal 2, corn meal 1, rice polish 1	3	.....	35	.....	.....	500	.....
Corn meal 1, rice polish 1	3	.....	35	.....	420	.....	.....

In every instance where data were furnished, the pigs on rice polish show more rapid gains than those on corn meal or mixed grain rations. In only two cases did rice polish fail to prove more economical. One of these was the second test with corn meal, where 670 pounds of feed were required by the pigs on both rations. The other was a test with

a mixed ration, where 2 parts cowpea meal, 1 part corn meal, and 1 part rice polish, with skim milk, gave gains at an outlay of 178 pounds grain and 413 pounds skim milk, as compared with 193 pounds grain and 474 pounds skim milk by the ration of rice polish and skim milk.

Duggar summarized the results where rice polish and corn meal were compared directly, and found that an average of 373 pounds of rice polish were required to produce 100 pounds gain, as compared with 474 pounds of corn meal. "At this rate, 78.6 pounds of rice polish were equal to 100 pounds of corn meal, a saving of 21.4 per cent of the grain by the substitution of polish for corn meal."

Gluten meal compared with corn meal.—Pigs that had been fed without success on a potato ration at the Cornell Station[a] were given a "rational ration" of corn meal and skim milk for a week and then they were employed in a test to compare gluten and corn meal. Skim milk was fed, the proportion to meal being about 3 pounds of milk to 1 of meal. Lots I and III received gluten meal and milk, and Lots II and IV corn meal and milk.

Gluten meal was charged at $11.75 per ton, corn meal at $14 per ton, and skim milk at 15 cents per 100 pounds.

The following were the principal results:

Gluten meal compared with corn meal for pigs.

Ration.	Number of pigs.	Average weight at beginning.	Total gain.	Number of days fed.	Average daily gain.	Dry matter per 100 pounds gain.	Cost per 100 pounds gain.	Dressed weight.	Nutritive ratio.
		Pounds.	*Pounds*		*Pounds.*	*Pounds.*	*Dollars.*	*Per cent.*	
Gluten meal and milk.	4	87.25	214	50	1.07	319	2.70	77.40	1:2.7
Corn meal and milk..	4	90.5	297.5	50	1.49	264	2.50	80.20	1:5.8
Gluten meal and milk.	4	47.5	157.5	50	.79	252	2.40	.....	1:2.7
Corn meal and milk..	4	48.5	219	50	1.10	151	1.90	.....	1:5.8

The use of gluten meal in combination with skim milk in this experiment did not give results so satisfactory as where corn meal and milk were fed. Both corn meal lots made better gains and the average of dry matter consumed, and cost per 100 pounds gain were much lower than with the pigs on gluten meal and milk.

Hominy meal compared with corn meal.—In Massachusetts the Hatch Station[b] compared hominy meal and corn meal. The latter is described as consisting of "the hulls, germs, and some of the starch and gluten of the corn ground together. This separation is said to be brought about solely by the aid of machinery. The hard flint part of the corn is the hominy, which is used as a human food."

Seven Chester White grades were fed on a grain and skim-milk ration, 7 to 10 quarts of skim milk being fed daily with a grain allow-

[a] Bul. No. 199. Cornell Univ. Expt. Sta.
[b] Eleventh An. Rpt., Hatch Expt. Sta.

ance of 3 to 6 ounces to each quart of milk, depending on appetite and size. One lot received corn meal and milk, and the other hominy meal and milk. The results are shown in the following table:

Hominy meal compared with corn meal for pigs.

Ration.	Number of pigs.	Average weight at beginning.	Total gain.	Number of days fed.	Average daily gain.	Total feed eaten.		Feed per 100 pounds gain.		Dry matter per 100 pounds gain.
						Grain.	Milk.	Grain.	Milk.	
		Lbs.	*Lbs.*		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
Corn meal	4	56	503	98	1.28	1,022	7,702	203	1,532	321
Hominy meal	3	58	410	98	1.39	766	5,779	187	1,410	306

These figures show hominy meal, as fed in this experiment, to have a feeding value equal to that of corn meal. In this one test corn meal failed to give quite so good results as the hominy meal, showing an average daily gain of 1.28 pounds to 1.39 pounds for hominy meal, and 320 pounds dry matter for 100 pounds gain to 306 pounds dry matter for 100 pounds gain in the case of the hominy meal.

Corn meal compared with cerealine feed.—Two tests were made at the Hatch Station[a] to compare corn meal and cerealine feed. Like hominy meal, cerealine feed "consists also of the hull and a portion of the starch of the corn. It contains rather less of the starch than the hominy meal. It is the by-product resulting from the preparation of the breakfast food known as cerealine flakes. It is very coarse looking and appears very much like unground corn hulls."

In the first test 6 grade Chester White pigs about five weeks old were used. They were fed 6 to 9 quarts of skim milk per head daily, and the grain fed at the start was 3 ounces for each quart of milk; the grain was increased with age and weight. The nutritive ration was 1:3 at the beginning and 1:7 at the close.

In the second test 6 pigs, "a cross between the Poland China and the Chester White," about five weeks old, were fed. Skim milk was fed in connection with the cerealine feed, which was "eaten with seeming relish at all times." The following table shows the results:

Cerealine feed compared with corn meal for pigs.

Ration.	Number of pigs.	Average weight at beginning.	Total gain.	Number of days fed.	Average daily gain.	Total feed eaten.		Feed per 100 pounds gain.		Dry matter per 100 pounds gain.
						Grain.	Milk.	Grain.	Milk.	
		Lbs.	*Lbs.*		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
Corn meal	3	48	413	106	1.30	731	4,827	177	1,169	289
Cerealine feed	3	45	398	106	1.25	731	4,827	184	1,212	277
Corn meal	3	68	315	78	1.34	680	3,061	216	972	281
Cerealine feed	3	67	293	78	1.25	676	3,061	231	1,041	305

[a] Eleventh An. Rpt., Hatch Expt. Sta.

In these tests cerealine feed showed considerable value as a pig feed, but failed to give as good results, either in rate or economy of gain, as corn meal. Digestion experiments at the Hatch Station with sheep have shown that cerealine feed contains as much digestible matter as corn meal. The station authorities suggest that the coarse nature of cerealine feed lessens its value as a pig feed.

Value of corn hearts.—Duggar[a] fed three lots of 3 pigs each to compare corn hearts with corn meal and cowpea meal. These feeds constituted half the ration, the other half being rice bran. The following table shows the results:

Value of corn hearts.

Ration.	Number of pigs.	Total gain.	Number of days fed.	Average daily gain.	Feed eaten.	Feed per 100 pounds gain.
		Pounds.		*Pounds.*	*Pounds.*	*Pounds.*
Corn hearts 1, Rice bran 1	3	65	35	0.62	480	738
Cowpea meal 1, Rice bran 1	3	81	35	.77	479	595
Corn meal 1, Rice bran 1	3	98	35	.93	540	550

Analyses at the Alabama Station indicated that the corn hearts used in this experiment contained 8.9 per cent protein and the rice bran 9 per cent protein.

Gluten meal compared with linseed meal for balancing rations.—Patterson, at the Maryland Experiment Station,[b] fed four lots of 5 high-grade Poland China pigs each to compare gluten meal and linseed meal as the nitrogenous components of a ration. Lots I and II received hominy chop three-fifths, linseed meal two-fifths; Lots III and IV received hominy chop three-fifths, King gluten meal two-fifths. Both lots had skim milk in the proportion of 1 pound of milk to 1 of grain. The results were as follows:

Gluten meal compared with linseed meal in a carbonaceous ration.

Ration.	Number of pigs.	Average weight at beginning.	Total gain.	Number of days fed.	Average daily gain.	Feed per 100 pounds gain.		Cost per 100 pounds gain.
						Grain.	Milk.	
		Pounds.	*Pounds.*		*Pounds.*	*Pounds.*	*Pounds.*	*Dollars.*
Hominy chop ⅗, linseed meal ⅖	5	37	298	60	0.99	242	242	2.71
Hominy chop ⅗, linseed meal ⅖	5	36	294	60	.98	242	242	2.70
Average						242	242	2.70
Hominy chop ⅗, gluten meal ⅖	5	36	241	60	.80	233	233	2.20
Hominy chop ⅗, gluten meal ⅖	5	37	256	60	.85	220	220	2.07
Average						226	226	2.13

[a] Bul. No. 122, Alabama Expt. Sta.

[b] Bul. No. 63.

This table shows advantages in favor of gluten meal. Both rate and economy of gain favor the corn by-product. The cost of the gluten-meal ration was much less than the one into which linseed meal entered.

COTTON-SEED MEAL.

No feed of the South has so wide a range of interest as cotton-seed meal. It is a concentrated feed of high value for cattle and sheep, and its effect on the fertilizing value of the manure is nearly as great as its effect on the feeding value of the ration.

The influence of cotton-seed meal extends far beyond the States where it is produced, and farmers over the entire country have come to depend upon it to balance their rations and enrich their fields.

Danger of use of cotton-seed meal in pig feeding.—For some reason as yet unexplained this by-product is usually fatal to pigs in from three to ten weeks after feeding has commenced, the mortality being at least 50 per cent. In two tests conducted by the Texas Experiment Station[a] boiled cotton seed gave the least serious results, while soaked raw seed, roasted seed, and raw meal proved more serious. In one test, 10 of the lot of 15 pigs fed cotton seed or cotton-seed meal died. At the Iowa Experiment Station,[b] of 6 pigs that were on a ration of cotton-seed meal, corn-and-cob meal, and buttermilk, 3 died. At the Kansas Experiment Station,[c] 4 young pigs on a ration composed of one-sixth cotton-seed meal and five-sixths corn meal died within forty-six days after feeding commenced. At the Arkansas Station,[d] three lots of 3 pigs each were fed mixed rations, the cotton-seed meal constituting one-third of the grain. All died.

The time intervening between the beginning of feeding cotton seed or cotton-seed meal and the first appearance of trouble varies somewhat. Curtis[e] gives six to eight weeks; Lloyd,[f] in one test, lost the first pig at the end of the fourth week; in another test, deaths began after forty days; Curtiss[g] lost the first pig fifty-one days after feeding commenced. Dinwiddie's[h] first pig died thirty-five days after feeding commenced, and Duggar[i] lost the first pig thirty days after feeding commenced. It therefore appears that there is no very definite period of time that is required for the poison to manifest itself. However, Cottrell[j] states that cotton-seed meal may be fed for three to four weeks before danger is imminent, and Burtis and Malone[k] state that no case has come under their experience "where a pig has died if the cotton-seed meal mixture has not been continued longer than three weeks."

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[a] Bul. No. 21.
[b] Bul. No. 28.
[c] Bul. No. 53.
[d] Bul. No. 76.
[e] Bul. No. 21, Texas Expt. Sta.
[f] Bul. No. 60, Mississippi Expt. Sta.
[g] Bul. No. 28, Iowa Expt. Sta.
[h] Bul. No. 76, Arkansas Expt. Sta.
[i] Bul. No. 122, Alabama Expt. Sta.
[j] Bul. No. 95, Kansas Expt. Sta.
[k] An. Rpt. 1901–02, Oklahoma Expt. Sta.

Symptoms of poisoning.—Poisoning is manifested in a peculiar manner. In many cases pigs that are apparently well in the evening are found dead in the morning, and often the most careful watching fails to show any indications of indisposition. Where symptoms are present those most characteristic seem to be disorder of respiration, which is manifested by quickened breathing, coughing, or hiccough. Failing appetite usually calls the attention of the feeder to the approach of danger. Seldom more than two days intervene between the first symptom and death. Francis[a] gives the following symptoms of the trouble with the Texas pigs:

> The attack was sudden, as a rule; in fact, in a majority of cases an animal was found dead that had been apparently well twelve hours before. In those cases which we were fortunate enough to witness the symptoms were those of a sudden contraction of the diaphragm, producing a sound similar to hiccough in man. The animal stood with head near the ground, the flanks tucked up, the ears hanging pendulous, and the tail straight and limp. Some would lie flat on the belly—never on the side—while others would assume a sitting-up posture with the fore legs well apart. In several cases there was a marked elevation of temperature, the thermometer registering 106° F. per rectum. The circulation seemed very weak and rapid. * * * As a rule they were dead in an hour. * * * The gaspings became more and more frequent and violent, and after a few struggles the animal was dead. In the last moments great quantities of foam or froth would come from the nose or mouth.

The symptoms observed by Dinwiddie[b] are described as follows:

> The disease in all cases was of a type which might be described as acute. In several instances the animals were said to be "off feed" for one or two days before other symptoms were observed. Every animal which exhibited any symptoms at all died within twenty-four hours. It would remain by itself, standing, disinclined to move, breathing with extreme rapidity and jerking or "thumping" in the flanks, and before death frothing at the mouth and nostrils. Fever was absent or but slight; eyes dull and sometimes bloodshot. Coughing occasionally occurred.

Pathological features.—Francis[a] states: "On postmortem examination the digestive organs appeared normal throughout. The other abdominal organs appeared normal. The respiratory organs were full of foam. The lungs themselves were bright red and very much congested and doughy." Mayo[c] pronounced the death of the Kansas pigs to be due in all cases to "congestion and inflammation of the intestines, lungs, and heart;" but Niles[d] could find no assignable cause of death in the case of the Iowa pigs.

Dinwiddie,[b] in the Arkansas experiments, made postmortem examinations of 8 of the 9 pigs which died, and found a very constant condition of disorder. He says, in describing the first examination, the description of which applied to all cases:

> The body presented no external changes. Subcutaneous tissue showed blood extravasations in streaks and points. Blood engorgement of lymph nodes of neck

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[a] Bul. No. 21, Texas Expt. Sta.
[b] Bul. No. 76, Arkansas Expt. Sta.
[c] Bul. No. 53, Kansas Expt. Sta.
[d] Bul. No. 28, Iowa Expt. Sta.

and jaws. Respiratory and buccal mucous membrane dusky red. Pleural cavities contain a large quantity of yellow, cloudy fluid, compressing the lungs to less than half their normal bulk. In the pericardial sac there is a similar dropsical effusion, part of which has formed into a soft, yellowish-white clot. No evident pleuritis. Lung dark red, congested, and collapsed. Cavities of heart contain dark, soft blood clots; slight petechial extravasations on the epicardium. No obvious peritoneal effusion. Liver is dark in color, friable, and deeply blood-engorged, the lobular boundaries on section being unusually prominent, with dark-red depressed centers. Kidneys on section appear congested throughout, capsule nonadherent. * * *

The stomach and intestines often showed abnormal features. The small intestine (jejunum) frequently showed hyperemic patches on both the serous and mucous surfaces, and the large intestine and stomach in several cases contained considerable quantities of gravel. The urine was slightly albuminous in two cases. In one instance, where the brain was dissected, there was engorgement of the veins and sinuses of the dura mater, which extended "backward into the vessels of the neck."

The histological examination is described as follows:

Sections of the liver tissue reveal an intense congestion of the portal system, the intralobular capillaries especially being enormously engorged throughout and the liver cells compressed and shrunken. There is, however, no marked degeneration, and the nuclei take the stain in the normal manner. Sections of the kidney exhibit a similar capillary engorgement, though less intense. The glomerular tufts are compressed by edematous effusion into their capsules. A degenerative process in the cells of the urinary tubules or other marked pathologic changes were not demonstrated. In the spleen no distinct pathologic changes are found. Lung sections show a marked congestion of the capillary vessels, with edematous effusion and occasional blood extravasations, but without cellular proliferation or infiltration. There is no evidence of pneumonia or pleurisy.

Treatment.—As a rule, hogs suffering from the effects of cotton-seed poisoning, if taken from the cotton-seed ration and placed on rich green pasture, become apparently well in a week.[a] A similar result follows when they are simply deprived of the cotton-seed meal of the ration and given an ordinary grain ration. However, Burtis[b] reports a case where a pig died during the winter after a week's feeding on a straight corn diet that followed four weeks' feeding on a ration of one-fifth cotton-seed meal and four-fifths corn meal; and Dinwiddie and Duggar had similar experiences. In some cases pigs may pass through a season of cotton-seed meal feeding and thereafter be indifferent to it. Curtis[c] found that if a pig lived thirty days after the first appearance of trouble it could be regarded as immune from the effects of cotton seed, but the experience of others seems to contradict this. Dinwiddie[d] gives two months as the time

[a] Bul. No. 60, Mississippi Expt. Sta.; An. Rpts., 1900–01 and 1901–02, Oklahoma Expt. Sta.

[b] An. Rpt. 1901–02, Oklahoma Expt. Sta.

[c] Bul. No. 21, Texas Expt. Sta

[d] Bul. No. 76, Arkansas Expt. Sta.

required for a hog to be on cotton-seed meal before it can be regarded as immune.

The cause of poisoning not known.—The poisonous agent of cotton seed has not yet been determined. So far chemical and bacteriological examinations have revealed nothing to which can be attributed its dangerous character. The injurious action has been variously attributed to the lint on the seed, the large fat content, the highly nitrogenous composition, the sharpness of the hulls, the presence of a toxin, supposititious chemical or bacteriological changes in the meal, formation of poisonous crystals by metabolism, etc. Up to a certain period the amount of cotton seed or cotton-seed meal fed does not seem to have any influence on the health of the pigs, but the evidence on the subject is so meager that one is not justified in drawing conclusions as to the amount of meal that can be fed safely. Curtiss[a] inclines to the toxin theory; he found the amount which proved fatal in his investigation to be from 27 to 33 pounds of cotton-seed meal. Dinwiddie[b] holds that the belief that there is a toxic principle in the seeds of the cotton plant is the most reasonable one, and one that has not been disproved. The action seems to be more virulent with young than with older animals, which is characteristic of poisons. He points out that the amount fed to pigs is much larger in proportion to their body weight than that fed to cattle and suggests this as a reason for the supposed greater immunity of cattle. With a 1,000 pound steer, 4 pounds of cotton-seed meal is an amount equal to 0.4 per cent of the body weight. In the case of the pigs in the Arkansas experiments the proportion was about 1.5 per cent of the body weight at the beginning of feeding. The amount of cotton-seed meal eaten per head was 23, 25, and 45 pounds, respectively, in the three experiments at that station. Dinwiddie[c] calls attention to the fact that other animals are susceptible to cotton-seed poisoning and states that guinea pigs, to which he fed small quantities of cotton-seed meal along with bran, died in from two to three weeks. He also admits the possibility of ptomaine poisoning.

At the Alabama station two of Duggar's[c] experiments resulted fatally. In the first experiment the smaller pigs were the first to die. They averaged about 64 pounds, and 12.20 pounds of cotton-seed meal were eaten by each before death ensued. This was 0.25 pound daily per head, or 0.4 pound daily per 100 pounds live weight for forty days, and a total of 18.90 pounds per 100 pounds average live weight. Larger pigs in this experiment, averaging a little over 70 pounds, died when 16.60 pounds of cotton-seed meal had been fed per head. These pigs were fed 0.41 pound per head daily, or 0.53 pound

[a] Bul. No. 28, Iowa Expt. Sta.
[b] Bul. No. 122, Alabama Expt. Sta.
[c] Bul. No. 76, Arkansas Expt. Sta.

per 100 pounds live weight daily, for forty-three days; the total amount of cotton-seed meal fed was 21.60 per cent of the average live weight. In the second fatal experiment one of the pigs died "after having appeared gaunt and weak for two days." This pig averaged about 60 pounds in weight and up to the time of death had been fed 5.4 pounds of cotton-seed meal. This was a total of 9.2 pounds per 100 pounds live weight. The pig had not had more than 0.25 pound cotton-seed meal daily per 100 pounds live weight. The other pig in the same lot showed an unthrifty condition and the ration was changed. (See the Kansas experience on page 122, where a similarly small amount of cotton-seed meal produced fatal results.) The ration in both experiments was, cotton-seed meal one-fifth, corn meal four-fifths.

In another test with a ration of corn meal three-fourths, cotton-seed meal one-fourth, the pigs were noticed to be out of condition toward the thirty-fifth day, but no deaths occurred. They averaged about 118 pounds in weight, and the amount of cotton-seed meal which made them sick was 25.5 pounds. This was 21.4 pounds per 100 pounds live weight, or 0.61 pound daily per 100 pounds live weight.

The causes of death are regarded by Dinwiddie[a] as being both essential and contributory, the essential cause being the toxic principle supposed to be present. He describes the immediate cause of death as follows:

> In all our cases the immediate cause of death was obviously asphyxia, due to pressure on the lungs by the dropsical effusion into the pleural cavities. In its final manifestations the disease was an acute dropsy of the pleural and pericardial sacs. The congestion of the abdominal organs, and especially of the portal system, can be attributed to obstructed circulation through the collapsed lungs damming the blood back in the venous system, and hence a process secondary to the pleuritic effusion. That this portal engorgement was secondary to the pleural effusion, I infer from the absence of degenerative or other changes in the liver which could account for it and from absence of any marked peritoneal effusion. Ascites would be the first result of such extreme portal congestion if it were primary. All of these conditions, however, are necessarily the result of some fundamental cause, the nature of which is yet to be discovered. An acute hydrothorax and hydrops pericardii, unaccompanied by ascites and without any antecedent pleuritis, is a condition rarely met with in human pathology. Non-inflammatory dropsical effusion may be due to mechanical obstruction, cardiac disease, degenerative changes in the kidney or liver, or to physical or chemical changes in the blood itself. Neither of the first three causes appears to be in operation here. Further researches will probably show some grave alteration in the composition of the blood as the primary effect of acute cotton-seed meal poisoning. In hogs, at least, nervous derangements are not manifested, so far as I have seen.

Points that may in time lead to the discovery of the trouble are that old meal seems to be more fatal than fresh, that cotton-seed meal is more fatal than cotton seed in any condition, and that the poisonous agent is not in the oil, but seems to be entirely left in the cake

[a] Bul. No. 76, Arkansas Expt. Sta.

when the oil is expressed. It is also well known throughout the South that decomposed cotton seed has little, if any, dangerous character, and it has been pretty clearly established by the studies of Curtiss[a] and by the experience of practical feeders that the meal is so changed by the processes of digestion that hogs following steers which are being fed a heavy cotton-seed meal ration are not injured by the droppings.

Feeding value.—Disregarding, for the moment, the fatal effects of this product, let us consider its feeding value. The results from feeding either the whole grain or the meal have not been uniform, and have given rise to three opinions regarding its value as a pig feed—(1) that it is both worthless and dangerous; (2) that it is only fairly valuable and hardly worth the risk of feeding, and (3) that it is extremely valuable if means can be devised to feed it without fatal results.

The Kentucky Experiment Station[b] fed a ration of 1 part cotton-seed meal, 1 part wheat bran, and 2 parts corn-and-cob meal for twenty-eight days, when ship stuff replaced the cotton-seed meal, because the pigs refused it, whether fed wet or dry. No fatalities were reported, but the gains were unsatisfactory and the station came to the conclusion that, in Kentucky, "cotton-seed meal could not be fed profitably to hogs, whether for growth or fat."

Curtis[c] expresses himself in a similar tone, that, "After two years successive tests in feeding cotton seed and cotton-seed meal to hogs with a definite aim in view, and after practical attempts to use these products in a similar manner for the past ten years, we do not hesitate to express our candid opinion that there is no profit whatever in feeding cotton seed in any form or cotton-seed meal to hogs of any age; * * * that it is practically impossible to prepare cotton seed or cotton-seed meal in any manner so that hogs will eat it greedily."

Lloyd's[d] opinion, from his experience at the Mississippi Station, is somewhat similar. He had losses from raw cotton-seed meal, but none from those getting cooked seed, although these pigs became very sick and refused to eat. His gains were "neither satisfactory nor profitable." With one bunch of pigs the average daily gain was about 1 pound for the first two weeks, after which the gains were small, although the pigs did not lose their appetite and continued to eat with relish. The after effects of feeding in this case were detrimental, as the pigs never got into good condition.

At the North Carolina Station, Emery[e] fed an 88-pound pig for sixty-one consecutive days on a cotton-seed meal ration, the amount of cotton-seed meal varying from one-fourth pound daily at the beginning to 2 pounds daily at the close. Skim milk was fed during

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[a] Bul. No. 28, Iowa Expt. Sta.
[b] Bul. No. 19.
[c] Bul. No. 21, Texas Expt. Sta.
[d] Bul. No. 60.
[e] Bul. No. 109.

the first three weeks and green feed during the first six weeks. Two pounds of cotton-seed meal daily made the pig sick, and for twenty-two days the meal was dropped from the ration. Then the feed was made one-fourth cotton-seed meal, three-fourths wheat bran, with 12 pounds skim milk daily for ten days, after which corn meal was substituted for the cotton-seed meal. The feeding was unprofitable, but the pig did not die.

Among the instances where feeding was fairly profitable, the results at the New York (State) Station[a] may be noted. The intention was not to note the effects of cotton-seed meal feeding. Cotton-seed meal in amounts varying from one-thirteenth to three-tenths of the entire ration was fed, with good results, covering periods of from fifty-six to one hundred and thirty-nine days. Two pigs in a lot fed on wet feed were troubled with indigestion, and after the close of the trial one of them died from "congestion of the liver, following indigestion." This may have been cotton-seed meal poisoning. The pigs were on a ration in which there was three-tenths pound daily for sixty-three days.

Cary's[b] results in Alabama are remarkable because of the large quantities of cotton seed fed. He conducted three experiments in which cotton seed or cotton-seed meal were fed to 13 pigs. From 1½ to 4½ pounds of crushed cotton seed were fed per head daily. In two instances cotton-seed meal was fed, but in small amounts (three-tenths pound daily in one case and three-fifths pound in the other). The pigs receiving cotton-seed meal did not thrive, losing appetite; one of them received bran, the other corn meal in addition to the cotton-seed meal, and both had green feed. When they were taken from cotton-seed meal and placed on corn and pasture they recovered rapidly.

In the first test the pigs on crushed cotton seed made fairly good gains. They had some grain in addition, and all received green or succulent feed. In the second test 3 pigs were fed rations of corn meal and crushed cotton seed or ground cowpeas and crushed cotton seed. The rations were heavy—6 pounds when corn meal was fed and 6½ pounds when cowpeas were fed; the amount of cotton seed was more than half the ration. Fair gains were made and the after effect does not seem to have been serious, as the pigs did well when placed on pasture and fed corn. One pig in this lot had crushed cotton seed alone, being fed 4½ pounds daily. He lost in weight, but gained in size of frame. When turned on pasture and given corn he did well. Another pig that had 3½ pounds crushed cotton seed and 3½ pounds green rye daily lost 28 pounds in twenty-eight days. After the rye was discontinued the pig failed to thrive, but recuperated rapidly on pasture with corn.

In three cases where 3 pounds of crushed cotton seed were fed daily, with ground cowpeas and green rye or corn meal and green rye,

[a] Eleventh and Twelfth An. Rpts. [b] Bul. No. 68, Alabama Expt. Sta.

nominal gains were made. No disastrous effects followed when green feed was discontinued; subsequent treatment on pasture and corn gave good gains.

In a third test 2 pigs were fed for forty-nine days on a daily ration of 6 pounds of separator milk and 3½ pounds crushed cotton seed, then for fifty days on 6 pounds of whole milk and 3½ pounds crushed cotton seed. Their appetites failed twice, but they gained slightly in weight.

The length of time that cotton seed or cotton-seed meal was fed in these experiments was one hundred and five days in the first, ninety-one days in the second, and one hundred and nine days in the third. Although the pigs were occasionally off feed there were no fatalities.

Duggar's[a] experiments did not show very favorable results for cotton-seed meal as part of the pig's ration. In no case did the pigs so fed make so great an average daily gain as 1 pound, and the gains were usually expensive, whether the grain was fed alone or with green feed. Rations of corn meal only gave better results. One lot of 2 pigs, averaging 68 pounds, fed a ration of cotton-seed meal one-fifth, corn meal four-fifths, and grazed on sorghum, made an average daily gain of 0.53 pound for thirty-four days, at an outlay of 380 pounds of grain for 100 pounds gain. Another, averaging 68 pounds, on the same grain ration, but grazing peanuts, made an average daily gain for thirty-eight days of 0.94 pound, requiring 185 pounds grain for 100 pounds gain. Another lot made an average daily gain of 0.8 pound for twenty-eight days on a ration of cotton-seed meal one-fourth and corn meal three-fourths, requiring 384 pounds grain for 100 pounds gain, while a lot on corn meal only in the same test made an average daily gain of 1.1 pounds, but required 531 pounds grain for 100 pounds gain. Duggar found corn meal alone a more palatable ration than one to which cotton-seed meal had been added, and had difficulty in inducing pigs to eat a full allowance of a cotton-seed meal ration.

The Kentucky, Wisconsin, Iowa, Kansas, and Oklahoma experiment stations have published results that show cotton-seed meal to have considerable feeding value for pigs.

In Kentucky May[b] fed cotton-seed meal at intervals of one week as part of the ration to 20 grade Berkshire pigs during a three weeks' finishing period with very good results.

At the Wisconsin Station,[c] Henry fed two lots of 5 pigs each for thirty-five days on a ration of which one-half pound daily was cotton-seed meal. The feeding was alternated, one lot receiving oil meal while the other had cotton-seed meal. The rest of the grain ration was a mixture of equal parts of wheat shorts and corn meal. Skim milk and whey were fed, and the feeding was done in the fall and

[a] Bul. No. 122, Alabama Expt. Sta.
[b] Bul. No. 101, Kentucky Expt. Sta.
[c] Eleventh An. Rpt.

winter. The pigs were never sick nor off feed, and made their gains economically. The tabulation of results shows that while on cotton-seed meal the pigs required 5 per cent less feed than while on oil meal.

At the Iowa Experiment Station, Curtiss[a] fed two lots of 3 Poland China pigs each on a ration of corn-and-cob meal, cotton-seed meal, and buttermilk. One lot received one-half pound cotton-seed meal per head daily and the other 1 pound per head daily. The grain fed was soaked for twelve hours before feeding. Salt and ashes were also given. Everything went well until the sixth week, when the droppings of the pigs on the heavy ration became dark in color and somewhat hard. However, the appetite was not affected. The first pig died fifty-one days after feeding commenced, and a second went the day following. They had been on the heavy ration, but showed no signs of sickness, and their gains had been steady. Sixty-three days after the start a pig in the lot receiving one-half pound of cottonseed meal per head daily died, but not without symptoms of trouble. For a day or two before death he had shown a "failing appetite and quickened breathing." The rest of the pigs in this lot showed the same symptoms, but survived, although their gains were light. The Station veterinarian could find no assignable cause of death.

In this experiment the fatal quality of cotton-seed meal seemed to depend, to a certain extent, on the quantity fed. The first pigs to die were those in the lots receiving the heavier ration of cotton-seed meal. These pigs also made the better gains.

The Kansas Station[b] fed 4 small pigs a ration of one-sixth cotton-seed meal and five-sixths corn meal. The meal was stirred in water at feeding time. It was not relished at first, but when it was once eaten rapid gains were made. The first pig died twenty-three days after the feeding began, and "could not have eaten more than 5 pounds of cotton-seed meal altogether," a fact which seems to lessen the weight of the theory that the quantity eaten has an influence on the fatal property of the feed. This pig weighed about 18 pounds at the time of its death. The last pig died on the forty-sixth day of the experiment. (See Duggar's experiments, pp. 117, 118.)

Two sows weighing, respectively, 135 and 308 pounds were put on a ration of one-fourth cotton-seed meal and three-fourths corn meal for forty-five days; they gained 89 pounds each without signs of poisoning.

In a second test, 6 pigs that had been stunted by exclusive corn meal or ground wheat feeding were divided into two lots of 3 each and put on rations composed of one-fourth cotton-seed meal and three-fourths corn meal for one lot, and equal parts of these meals for the other lot. The change of condition is described as "magical" and

[a] Bul. No. 28. [b] Bul. No. 53.

immediate; the pigs began to gain in weight at once, and those receiving the greater amount of cotton-seed meal made the larger gains. No other feed was given. The first pig died on the forty-fifth day of the experiment, the second on the forty-eighth day, the third on the fifty-third day, and the fourth on the fifty-sixth day from the beginning of the cotton-seed meal feeding. Two pigs were left in each lot; they were placed on green oats and then thrived nicely.

A later bulletin[a] from the Kansas Station mentions a lot of pigs that had done poorly in another experiment; they were fed cotton-seed meal, and were "ready for market, well finished, in twenty-two days." At the Kansas Station cotton-seed meal is very highly regarded to put pigs in high condition, if fed for a short time in small quantities. The beginning ration is one-fourth pound cotton-seed meal to each 1,000 pounds live weight per day, which is increased in ten days to make the amount 3 pounds per 1,000 pounds live weight.[b] The meal is mixed with the rest of the grain.

The Kansas and Iowa results show that a cotton-seed meal ration is valuable if the cotton-seed meal is used in a moderate amount and for a limited time. The proportions of cotton-seed meal used in the Iowa test were about one-eighteenth and one-ninth of the total grain rations at the start and about one-tenth and one-fifth at the close. Up to the time the pigs began to die the gains of those on the heavier cotton-seed meal ration were the larger and more economical (1.4 pounds average daily gain and 343 pounds meal and 250 pounds milk per 100 pounds gain). The lighter ration was about equal in results to one of corn-and-cob meal, gluten meal, and buttermilk, that stood second to the heavy cotton-seed meal ration. The two lots returned in pounds of gain per 100 pounds of dry matter in the feed (before deaths began) 31.1 pounds and 26.4 pounds, respectively, for the pigs on the heavy and the light rations. In the Kansas tests the gains before deaths commenced were also very economical; they varied in cost from considerably less than 300 pounds grain per 100 pounds gain in the case of the pigs that had been previously on the single-grain rations to 350 pounds grain per 100 pounds gain in the case of the sows.

Pigs following steers on cotton-seed meal.—Evidence of the dangerous properties of cotton-seed meal for pigs, when they are following steers whose ration is made up wholly or in part of cotton-seed meal, is conflicting. In the Iowa test[c] a lot of 3 pigs followed steers for seventeen weeks that were receiving from 4 to 7 pounds of cotton-seed meal daily. They had very little feed except what they picked up behind the steers, yet there were no noticeable injurious effects.

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[a] Bul. No. 95.

[b] This is about the ration furnished dairy cows in milk.

[c] Bul. No. 28, Iowa Expt. Sta.

The Kansas Station[a] states that the meal used in their early experiments was shipped in from Texas during the previous winter by a local feeder, to be fed to steers. He turned about 40 hogs after them, and all died in the course of six or seven weeks. Considerable evidence that pigs may not suffer after steers that are fed on cotton-seed meal has recently been presented in the columns of the agricultural press.

THE OKLAHOMA EXPERIMENTS.

The Oklahoma Station has made an extensive study of the possibility of feeding this by-product so that good returns may be obtained with little or no danger from poisoning. The conditions under which it has been found that cotton-seed meal may generally be fed safely are (1) where pigs have access to range and plenty of green pasture, and (2) where periods of cotton-seed meal feeding of three to four weeks' duration without pasture are alternated with a period on pasture or on a ration from which the cotton-seed meal has been omitted.

Following up this system the Oklahoma Station has conducted three experiments. In the first trial, in 1900, the alternating method was tried with 17 thrifty shoats of various sizes.[b] They were put on a ration composed of one-fifth cotton-seed meal and four-fifths Kafir-corn meal and had the run of a large paddock, where they got a little green stuff. The trial began March 22. For twenty-seven days the cotton-seed meal ration was fed; then for fourteen days Kafir-corn meal alone, next fourteen days on one-fifth cotton-seed meal, and four-fifths Kafir-corn meal, then seven days without the cotton-seed meal, closing with five days on the original ration. "None of the pigs had died, and all made very fair gains on a moderate amount of grain." At the close of this trial part of the pigs were sold and the rest continued on the cotton-seed meal ration, with which the trial closed (one-fifth cotton-seed meal and four-fifths Kafir-corn meal). They were fed on this ration without change until July 14 with the loss of 1 pig only.

In the second trial of the same year 16 stunted shoats, about a year old and averaging 79 pounds were used. For twenty-six days from April 12, they were hurdled on wheat and fed a light ration of one-fifth cotton-seed meal and four-fifths Kafir-corn meal. There was no ill effect from the grain ration. The gains averaged 0.96 pound per head daily and were made economically. On May 8 the pigs were taken from the wheat and fed the same grain ration in a lot for twenty-one days with no serious results, making an average daily gain of 1.71 pounds at the expense of 307 pounds of grain for 100 pounds gain. Five of the largest were sold after forty-seven days continuous feeding on a cotton-seed meal ration.

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[a] Bul. No. 53. [b] An. Rpt., 1900–01.

The 11 pigs remaining were then given range and green feed and the same grain ration continued. The gains made were satisfactory. There were no losses, and they were sold on July 14, after ninety-three days' continuous feeding on a cotton-seed meal ration.

In 1901, 16 uniform Poland China shoats, farrowed late in the previous fall, were used.[a] They were about 11 weeks old at the beginning of the experiment and averaged about 47 pounds in weight. The experiment began January 11. The pigs were divided into four lots of 4 each. Each lot was given an open pen 9 by 24 feet, and had a space 8 by 8 feet in an inclosed piggery. Cob charcoal, wood ashes, and salt were always accessible; water only was given to drink, and the grain was mixed with water into the form of a thick slop just before feeding. From July 14 to April 1, 2 pounds of sugar beets were allowed each pig daily. The pigs were fed as follows: Lot I received corn meal only to April 5, then a mixture of one-fifth cotton-seed meal and four-fifths corn meal for four weeks, closing with two weeks on corn meal; Lot II received one-third corn meal and two-thirds wheat middlings; Lot III received one-fifth cotton-seed meal and four-fifths corn meal. Lot IV received one-fifth cotton-seed meal and four-fifths corn meal for four weeks, then corn meal for two weeks, next the cotton-seed meal mixture for four weeks, then back to corn meal only for two weeks, and alternating in this manner until the experiment closed.

The only signs of lack of appetite were in Lot I, where exclusive corn-meal feeding proved rather severe for such young pigs, and in Lot III, where a dullness of appetite was noticed for about two weeks. This was only temporary. One pig in Lot IV died on February 15, one week after it had been taken from the cotton-seed meal ration and placed on corn meal, and 2 pigs in Lot III died on February 20, after they had been on a cotton-seed meal ration continuously for forty days.[b] "No further losses occurred, * * * and the pigs thrived and made good gains." One pig in Lot IV showed symptons of sickness, but recovered.

After April 5, Lot I was given the same management and feed as Lot IV, but there were no injurious results. On the contrary, their gains increased. This was also noticed with Lot IV. During the periods that the hogs were on a straight corn-meal ration, except during the closing period, when their greater maturity enabled them to make use of a more carbonaceous ration, the gains were light and expensive, but when the cotton-seed mixture was resumed the gains were large and economical, disregarding the effect of loss by death.

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[a] An. Rpt., 1901–02.

[b] Dinwiddie had a similar experience. See Bul. No. 76, p. 147, Arkansas Expt. Sta.

The following table shows the results of the one hundred and twenty-six days feeding for the pigs that survived:

Feeding pigs on cotton-seed meal rations.

Ration.	Number of pigs.	Average weight at beginning, January 11.	Average weight at close, May 17.	Average gain.	Average daily gain.	Average amount grain eaten.	Grain per 100 pounds gain.	Cost of grain per 100 pounds gain.
Lot I:		*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Dollars.*
Corn meal	4	46	125	78	0.62	368	470	2.6
Lot II:								
Corn meal ½	4	46	191	146	1.15	539	370	2.0
Wheat middling ½								
Lot III:								
Cotton-seed meal ⅛	2	47	182	135	1.07	483	357	2.39
Corn meal ⅞								
Lot IV:								
Alternate rations.	3	44	178	134	1.06	493	368	2.1

Burtis and Malone suggest that had the cotton-seed meal lots been running on green pasture from the beginning of the experiment no losses would have occurred. They also suggest the probability that a ration of one-tenth to one-fifth cotton-seed meal may be fed for an indefinite time if pigs have the run of green pasture.

THE ARKANSAS EXPERIMENTS.

In addition to throwing light on the pathological features of cotton-seed poisoning, Dinwiddie[a] has corroborated the results of those stations, which have shown that, when properly fed, cotton-seed meal is a valuable pig feed, if losses can be avoided. In the experiments in which all the pigs died, Lot I received a ration of cotton-seed meal 1 part and corn chops 3 parts; Lot II received cotton-seed meal 1 part, and corn meal 3 parts, with roots; Lot III received cotton-seed meal 1 part and wheat bran 3 parts, and Lot IV received bran 1 part and corn chops 3 parts. There were three pigs in each pen, and feeding began January 1, 1902. The pigs were confined in pens with an open shed for shelter, were watered and fed twice daily, and had a mixture of hard-wood ashes and salt supplied constantly. The results are tabulated as follows:

Feeding pigs on cotton-seed meal rations.

Lot.	Number of days until first death.	Eaten per head.	Eaten daily per head.	Eaten daily to initial weight.	Initial weight.	Daily gain per head	Daily gain to initial weight.
		Pounds.	*Pounds.*	*Per cent.*	*Pounds.*	*Pounds.*	*Per cent.*
Lot I	35	23	.68	1.6	41	0.9	2.2
Lot II	40	25	.64	1.5	42	1	2.4
Lot III	61	45	.80	1.6	48	1	2.1
Lot IV					47	.9	1.9

[a] Bul. No. 76, Arkansas Expt. Sta.

Dinwiddie points out particularly that a corn-meal and cotton-seed-meal ration, which one would naturally select as giving the proper proportions between nitrogenous and carbohydrate constituents, proved the most fatal in his experiments, and that the bran and cotton-seed meal ration, the most nitrogenous of the three, required the most time for the dangerous property to assert itself. Contrary to what one would expect from the Oklahoma results, roots did not have so good an effect as the wheat bran.

The pigs received from 0.64 to 0.8 pound of cotton seed per head daily, which was from 1.5 to 1.6 per cent of their initial body weight. The first death occurred in the case of the pigs on corn and cotton-seed meal thirty-five days after the feeding commenced, an average of 23 pounds cotton-seed meal being eaten per head. In the case of the pigs fed corn, cotton-seed meal, and roots, the first death was forty days after the beginning, an average per head of 25 pounds of cotton-seed meal being eaten. The first death in the case of the pigs on bran and cotton-seed meal occurred sixty-one days after the beginning, 45 pounds of cotton-seed meal being eaten per head. Up to the time of death the gains of the pigs on cotton-seed meal were as good or better than those of the pigs on corn chops and bran (Lot IV).

Following the experiment in which all the pigs on cotton-seed meal died, Dinwiddie[a] fed 4 native pigs, averaging about 50 pounds in weight, on various rations, cotton-seed meal being a prominent factor, constituting one-fourth of the ration. Turnips were fed for eighty days, after which rye, oats, and alfalfa were given for two months. The pigs were fed from February 26 to November 6, 1902. Only 1 received cotton-seed meal throughout the experiment, and for a small part of the time none was given to it. The other pigs received rations of equal parts of bran and corn meal or ear corn after being taken from the cotton-seed-meal ration.

Dinwiddie presents the following tabulation of the results of this experiment:

Feeding pigs on cotton-seed meal rations.

Designation of pig.	Number of days fed cotton-seed meal.	Weight of cotton-seed meal eaten.	Weight of cotton-seed meal eaten daily in first period (80 days).	Daily consumption of cotton-seed meal to initial weight.	Weight of cotton-seed meal eaten daily in second period (59 days).	Weight of cotton-seed meal eaten daily for remainder of test.
		Pounds.	*Pounds.*	*Per cent.*	*Pounds.*	*Pounds.*
A	139	80	0.58	1.4	[a] 0.55	.....
B	248	242	.58	1.4	.55	[b] 1.5
C	198	137	.58	1.4	.55	[c] 1
D	198	137	.58	1.4	.55	[c] 1

[a] Decrease probably due to a larger supply of green feed.
[b] One hundred days. (Cotton-seed meal 1, corn meal 3.)
[c] Fifty-nine days.

A third test[a] was made in which rations of cotton-seed meal 1 part and bran 3 parts and cotton-seed meal 1 part and wheat chops 3 parts

[a] Bul. No. 76, Arkansas Expt. Sta.

were fed. The former ration was fed for ninety-five days to 6 pigs, which averaged about 50 pounds in weight. The latter was given for ninety-nine days to 4 Tamworth pigs, averaging about 50 pounds in weight. The following table shows the results:

Feeding pigs on cotton-seed-meal rations.

Ration.	Number of pigs.	Time fed cotton-seed meal.	Average amount cotton-seed meal eaten.	Average amount cotton-seed meal eaten during first month.	Cotton-seed meal to estimated initial body weight.	Average amount cotton-seed meal eaten daily after first month.	Cotton-seed meal eaten daily during test.
		Days.	*Pounds.*	*Pounds.*	*Per cent.*	*Pounds.*	*Pounds.*
Cotton-seed meal 1, bran 3	6	95	54	0.4	0.8	0.6	0.5
Cotton-seed meal 1, wheat chops 3	4	99	57	[a].4	18	[b].7	.5

[a] First half of period. [b] Last half of period.

There were no losses from these rations, and the pigs made small gains.

Effect of cotton-seed meal on pregnant sows.—Dinwiddie[a] fed a native sow carrying her third litter on a ration of cotton-seed meal 1 part and bran 3 parts for eighty days before farrowing. She ate a total amount of 112 pounds of cotton-seed meal, which was 1.39 pounds daily and 0.8 per cent of the estimated initial body weight. The ration agreed with her and there appeared to be no harmful effects on the fetal litter, it being farrowed safely, with no stillbirths.

Effect of crude cotton oil.—Dinwiddie[a] fed 3 pigs on a ration of corn meal 1 part, wheat bran 2 parts, and crude cotton oil 0.1 to 0.4 part. The amount of cotton oil fed (estimating the fat content of cotton-seed meal at 14 per cent) was equivalent to that contained in from 0.25 to 1.8 pounds of cotton-seed meal, the smaller amount having proved fatal in the Arkansas results, already discussed. These pigs were on the cotton-oil ration one hundred and forty-four days. The amount of oil fed for the entire time to each pig was 21 pounds, equivalent to 150 pounds of cotton-seed meal. The average daily amount of oil consumed varied from 0.06 pound (meal equivalent, 0.4 pound) to 0.24 pound (meal equivalent, 1.6 pounds). The average daily amount of oil fed for the entire test was 0.14 pound (meal equivalent, 1 pound). The pigs made an average daily gain of 0.6 pound, and suffered no serious effects from the oil.

Use of cotton-seed meal in the feed lot.—The use of cotton-seed meal in the feed lot must be very carefully guarded, especially until the conditions under which it may be used without danger and the circumstances which govern the demonstration of its poisonous properties are more thoroughly understood. The feeding of the cotton-seed meal which the South produces is one of the greatest problems of agri-

[a] Bul. No. 76, Arkansas Expt. Sta.

culture in that section yet to be solved satisfactorily. It is not difficult to appreciate what may be gained if some of this by-product, which has such high feeding and fertilizing value, and which is exported in such enormous quantities, can be converted into pork products, which are now largely imported from other States.

PACKING-HOUSE PRODUCTS.

The frugality of the modern meat packer has become almost proverbial. Less than twenty years ago the disposal of the offal of slaughtering was a problem, but at present there is very little waste, and the packer has actually come to regard the by-products as the principal source of profit in his business. The preparation of these by-products for use as animal feed is one of the later developments of this branch of the industry. Fertilizers have long been prominent in the sales, the material that enters into their composition being meat scraps, blood, bone, hair, intestinal contents, etc. The use of tankage, a by-product that has had its sale entirely as a fertilizer, is growing among pig feeders, and has been studied by Plumb and Van Norman at the Indiana Station, and by Kennedy and Marshall at the Iowa Station. Beef meal is also a packing-house product, whose feeding value was studied along with that of tankage in the Iowa experiment.

Character of packing-house by-products.—Plumb and Van Norman[a] state that tankage may contain scraps of meat, intestines, and their contents, hair, etc. It is classed as *concentrated* and *crushed* tankage. Concentrated tankage is not used for animal food. Crushed tankage is said to be of several grades, being graded according to the ammonia and phosphoric-acid content, although it is probable that the tankage graded as No. 1 is free from the contents of intestines.

Kennedy and Marshall[b] used two brands of tankage made by Chicago packers. One of these is described as follows:

> Digester tankage is made from meat scraps, fat trimmings, and scrap bones. These are taken up as fast as taken from the animals and put into a large steel tank and cooked under a live steam pressure of 40 pounds to the square inch, which cooks out the tallow. After the steam is turned off it is allowed to settle, when the grease rises to the top and is drawn off. After the grease is drawn off the tankage is kept agitated, and by evaporation the water is extracted until the tankage contains about 8 per cent moisture. It is then taken out of the tank, allowed to cool, is ground, and stored ready for shipment. This tankage is supposed to contain about 60 per cent protein and 10 per cent fat.

The manufacture of the other tankage is thus described:

> This product, like the one just described, is made from meat scraps, scrap bones, etc. Quoting the words of the manufacturer, it is as follows: "Tankage is the product which drops to the bottom in our rendering tanks when we are rendering out grease, tallow, etc., at our various packing houses. It has been thoroughly cooked under 40 pounds pressure for several hours, which thoroughly destroys any disease germs which might possibly be in the raw meat. This product is

[a] Bul. No. 90, Indiana Expt. Sta. [b] Bul. No. 65, Iowa Expt. Sta.

pressed and then dried in steam driers at a high temperature. It is then ground and shipped in 100 and 200 pound sacks."

The beef meal, used in the Iowa[a] test, is described as follows:

This product is made from scraps of meat and bone from which the grease has been extracted and the liquors concentrated by cooking. These are then pressed, dried, and ground in preparation for the market. It is claimed to contain from 40 per cent to 50 per cent of protein.

Analyses of packing house by-products.—The analysis of tankage reported by the Indiana Station is as follows:

	Per cent.
Moisture	8.63
Protein	49.81
Ether extract	15.78
Crude fiber	4.78
Nitrogen-free extract	5.06
Ash	15.94
	100

The Iowa Station analyses, including that of the corn meal used, are as follows:

Analyses of feeding stuffs. (Weems.)[a]

Ration.	Water.	Ash.	Protein.	Crude fiber.	Nitrogen-free extract.	Ether extract.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Corn meal	11.05	1.55	15.25	4.85	63.80	3.50
Beef meal	6.10	15.60	61.10	5.20	3.12	8.88
Tankage	6.25	12.85	42.15	6.95	15.50	16.30
Do	9.05	20.65	39.10	10.90	8.60	11.70

[a] Bul. No. 65, Iowa Expt. Sta.

Feeding tankage in a corn-meal ration.—In the Indiana[b] experiment 16 young pigs were fed to determine the value of tankage. The pigs were purebred Poland Chinas and Berkshires. There were 4 lots, 2 of each breed in each lot. The tankage was specially prepared by the packers who furnished it to the experiment station, and was "made from bones and meat taken from the cutting room, tanked immediately, and pressed and dried."

The conditions of the experiment were equal for all lots; all had an opportunity for getting exercise and each lot was in a separate inclosure. There was no sickness and Lot III was the only one showing lack of appetite at any time. The pigs were fed as follows: Lot I, 10 parts corn meal and 1 part tankage; Lot II, 5 parts corn meal and 1 part tankage; Lot III, corn meal; Lot IV, 10 parts of a mixture of equal parts of corn meal and shorts and 1 part tankage. The feed was weighed out and then mixed with tepid water in the proportion of about 2 parts of water to 1 part of feed, a slop of medium thinness being made. Each lot of pigs had access to ashes and salt. The cost

[a] Bul. No. 65, Iowa Expt. Sta. [b] Bul. No. 90, Indiana Expt. Sta.

of feed used was as follows: Corn meal, $20 per ton; shorts, $16 per ton; tankage, $30 per ton.

At the Iowa Station[a] five lots of 6 pigs each, averaging 205 pounds, were fed for forty-nine days, to note the value of packing-house products. "Each lot contained 3 crossbred Poland China-Yorkshires, 2 Poland China-Duroc Jerseys, and 1 Poland China-Berkshire." Corn was used as the basis of comparison and the pigs were fed as follows: Lot I received corn meal alone; Lot II received about 5 parts of corn meal and 1 part of beef meal;[b] Lot III received about 5 parts of corn meal and 1 part of digester tankage; Lot IV received about 5 parts of corn meal and 1 part of tankage.

The market prices of the corn meal and tankage are given as follows: Corn meal, $22 per ton; digester tankage, $32 per ton; tankage, $25 per ton.

The Iowa pigs were shipped to Chicago and the lots were sold separately. They brought $7.55, the extreme top of the market for the day of sale.

The following table shows the results of these experiments:

Tankage in a corn-meal ration for pigs.

Ration.	Number of pigs.	Average weight at beginning.	Total gain.	Number of days fed.	Average daily gain.	Feed eaten.		Feed per 100 pounds gain.		Cost per 100 pounds gain.
						Grain.	Tankage.	Grain.	Tankage.	
Indiana:		*Lbs.*	*Lbs.*		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Dollars.*
Corn meal 10... Tankage 1.....	4	59	589	127	1.16	1,982	* 197	337	33	3.80
Corn meal 5.... Tankage 1.....	4	58	625	127	1.23	1,984	379	317	61	4.00
Corn meal	4	58	342	127	.67	1,779	.....	520	.....	5.20
Corn meal and shorts 10 ..... Tankage 1.....	4	58	579	127	1.14	2,001	199	346	34	3.60
Iowa:										
Corn meal	6	197	596	49	2.08	2,747	.....	461	.....	5.10
Corn meal and digester tankage	6	202	757	49	2.57	2,429	458	321	61	4.50
Corn meal ..... Tankage	6	198	668	49	2.27	2,438	460	365	69	4.90

These experiments seem to show that tankage has a great deal of value for balancing a pig's ration.

In the Indiana test the use of tankage lessened the amount of grain required per 100 pounds gain from 203 pounds to 175 pounds—from 38.9 to 33.5 per cent—showing tankage to be very profitable with the prices that were charged for grain in this instance.

[a] Bul. No. 65.

[b] One lot of pigs in this experiment were fed to note the value of condimental feeds. (See pp. 133, 134 for the results.)

In the Iowa test 140 pounds and 96 pounds, respectively, were saved by the use of tankage—30.4 and 20.8 per cent—not so good a record as obtained in Indiana. The difference between the money cost per 100 pounds of the corn-fed and tankage-fed lots was also much less than in Indiana.

The condition of the pigs in the Indiana test was remarked upon. The tankage-fed pigs handled better, had finer, silkier coats, and ate with much more relish than those on corn alone. The corn-fed lot was conspicuous by reason of its poor condition.

At the conclusion of their experiments, Plumb and Van Norman gave the pigs that had been on corn meal a ration of 5 parts of corn meal and 1 part tankage for forty-nine days. There was immediate improvement in their appetites, the hair softened, and the skin handled better. There was a marked improvement in growth, which contrasted strongly with the gains made while on corn meal only.

Experimenters caution stockmen to use that tankage only which has been specially prepared for feeding purposes.

Beef meal in a corn meal ration.—The results of the lot of pigs that were fed beef meal at the Iowa Station are compared below with those on corn meal. The price of the beef meal used in this test was $22 per ton.

Beef meal in a corn-meal ration for pigs.

Ration.	Number of pigs.	Average weight at beginning.	Total gain.	Number of days fed.	Average daily gain.	Feed eaten.		Feed per 100 pounds gain.		Cost per 100 pounds gain.
						Grain.	Beef meal.	Grain.	Beef meal.	
		Lbs.	*Lbs.*		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Dolls.*
Corn meal	6	197	596	49	2.08	2,747	.....	461	.....	5.19
Corn meal 5 parts, beef meal 1 part.	6	197	707	49	2.40	2,448	458	346	65	4.89

Beef meal, like tankage, seems to be valuable in the pig's ration. The amount of grain saved per 100 pounds gain by the use of beef meal was 115 pounds, or 24.9 per cent.

SUGAR BY-PRODUCTS.

Feeding beet molasses.—Clinton[a] fed 5 pigs averaging 87 pounds on a ration of corn meal 8 pounds, beet molasses 12 pounds, and skim milk 20 pounds. "This quantity was given in two daily feeds, and the pigs apparently did not relish the molasses, yet they ate it." Three days after feeding commenced they ate the morning feed well, but within an hour 1 pig was dead and another died a few hours later. Postmortem examination indicated poisoning. The surviving pigs were then placed on a corn meal and milk ration, but made expensive gains, the cause assigned being the effect of molasses feeding.

[a] Bul. No. 199, Cornell Univ. Expt. Sta.

This experiment had results similar to those of German investigators with beet molasses. It may be that this by-product is not a safe feed for pigs. However, other molasses by-products in sugar production, such as cane molasses, are valuable for feeding horses, cattle, and sheep, and many farmers value highly the "skimmings" from sorghum vats as a fattening feed for pigs. There are very few experimental data on the feeding value of the by-products from sugar refining.

CONDIMENTAL FEEDS.

Two experiments are noted which deal with the value of condimental stock feeds in pork production. These feeds have quite general use over the country, and, on account of strict legislative regulations and the supervision and analyses by the experiment stations, they are generally of high feeding value, having a high nutrient content. They are prepared with palatability in view and often contain some harmless drug that increases the attractiveness of the feed and may have a good effect on the digestive functions. They are thus frequently found valuable where animals are being crowded or are suffering from the effects of improper feeding. Oil meal usually forms the basis of these feeds and is supplemented by bran, bean meal, cotton-seed meal, ginger, fenugreek, etc. These feeds range in price per ton from $30 to $500. The manufacturers generally direct that they be used in very small amounts.

Feeding experiments.—At the Indiana Station Plumb[a] fed two lots of 4 pigs each to determine the value of American stock food. The pigs were gilts, four months old. There were 3 Poland Chinas and 1 Chester White in each lot. The experiment lasted one hundred and twenty-two days. Lot I was fed a mixture of equal parts of shorts and hominy feed and a small amount of American stock food; Lot II received the same ration without the stock food. At the Iowa Station Kennedy and Marshall[b] fed two lots of 5 crossbred pigs each averaging 205 pounds. One lot on corn meal and Standard stock food was compared with a lot on corn meal alone. The following are the results of the two tests:

Feeding pigs with and without stock food.

Ration.	Number of pigs.	Average weight at beginning.	Total gain.	Number of days fed.	Average daily gain.	Feed eaten.		Feed per 100 pounds gain.		Cost per 100 pounds gain.	Profit per pig.
						Grain.	Stock food.	Grain.	Stock food.		
Indiana:	*Lbs.*	*Lbs.*	*Lbs.*		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Dolls.*	*Dolls.*
Stock food	4	66	682	122	1.42	2,547	64	373	9.38	3.00	[c]9.66
No stock food.	4	65	689	122	1.43	2,581	.....	375	.....	2.60	[c]13.94
Iowa:											
Stock food	5	197	655	49	2.23	2,858	14	436	2.14	5.00	2.64
No stock food.	5	197	596	49	2.08	2,747	.....	461	.....	5.10	2.39

[a] Bul. No. 93. [b] Bul. No. 65. [c] Profit per lot.

The Indiana results show that nothing was gained by the use of the prepared feed; in fact, there was indicated a decided disadvantage, as more feed was required per 100 pounds of gain and the profits were very much less than with the lot not having the prepared feed.

The Iowa results show a saving in cost of 10 cents per 100 pounds gain for the pigs receiving Standard stock food and a net profit per pig of 25 cents in favor of this lot as compared with pigs on corn meal alone. It is needless to point out that the results of these two experiments should not be too closely compared. In addition to the stock food given one lot, all the Indiana pigs were on a mixed ration; whereas in the Iowa test the stock food was the only variation from corn meal that was permitted. The results from adding any palatable feed to a straight corn-meal ration will be greater than the addition of the same or a similar feed to a mixed ration, because in the one case variety is the greatest necessity of the ration, while in the other it is already present. The same, if not very much better, results would have been seen had pigs on a ration of corn meal and green or succulent feed or dairy by-products been compared with pigs on a ration of corn meal only; and oil meal would probably have had a similar effect. While some of the difference in results may have been due to a difference in the quality of the two stock foods, it would naturally be expected that not only a better showing in rate and economy of gain for the stock food when conditions resemble those of the Iowa test would be made, but it would also be expected that there would be a relatively greater showing from the standpoint of total feed eaten. Both of these results are manifest; indeed, in the Indiana test the stock food seems to have had no effect whatever on the appetite.

Plumb[a] mentions a test by a student at Purdue University where Rauh's stock food was fed to 3 pigs for thirty-five days, after which they received Standard stock food for forty-nine days. They had equal parts of corn meal and shorts, and were compared with a lot of 3 pigs on corn meal and shorts only. There was a total gain of 2.5 pounds in favor of the prepared food first mentioned. The total balance was 21 pounds of gain in favor of the condimental feed. The results were as follows:

Feeding pigs with and without stock food.

Ration	Average weight at beginning.	Total gain.	Number of days fed.	Average daily gain.	Feed eaten.		Feed per 100 pounds gain.		Cost per 100 pounds gain.	Total profit.
					Grain.	Stock food.	Grain.	Stock food.		
	Pounds.	*Pounds*		*Pounds.*	*Pounds.*	*Ounces.*	*Pounds.*	*Ounces.*	*Dollars.*	*Dollars.*
Stock food	63	387	84	1.54	1,355	100	350	25.8	4.19	6.98
No stock food.	63	366	84	1.45	1,325	.....	362	.....	4.22	6.50

[a] Bul. No. 93, Indiana Expt. Sta.

These results favor the stock food in about the same proportion as in the Iowa test.

DAIRY BY-PRODUCTS.

The use of the by-products of the dairy and creamery (skim milk, buttermilk, and whey) is one of the most interesting subjects of study in pork production. The value of the milk is known on every farm, although it may not be fully appreciated, and anyone who has fed pigs knows the keen appetite that these animals have for milk and its products. In the neighborhood of many large dairies pork production has become a very prominent and lucrative branch of the dairy industry.

Regarding solely their chemical composition, the by-products of the dairy contain most of the indispensable feeding constituents of the milk from which they are produced.

The residue from the separation of cream (skim milk) and that from churning (buttermilk) leave two products that contain practically all the protein and carbohydrates of the whole milk. In cheese making, the whey that is left is the least valuable of the dairy by-products, the greater part of the casein and fat of the milk being retained in the cheese. While whey is by no means worthless for feeding purposes, it can readily be seen that if skim milk and buttermilk have higher feeding values for pigs than whey, butter making and pig feeding will more profitably accompany each other than will cheese making and pig feeding. These by-products supply growing material to young animals and provide an excellent nitrogenous balance in the fattening ration. The constituents that remain in the milk after skimming and churning are the most expensive ones, considered from the standpoint of feeding and fertilizing value, and it is largely due to this fact that dairy farming is so often a profitable business when conducted in a thorough manner.

The value of dairy by-products is not alone in their nitrogenous character. They have an effect on the digestion that brings results out of all proportion to their nutritive value. Where pigs have been for a long time on a monotonous ration, such as corn meal alone, they lose appetite, become listless, and sick, and so make very unsatisfactory gains. If skim milk is given, even in very small amounts, an immediate change for the better is noticed—appetite returns and the pigs begin to gain rapidly in weight. As already stated, the gain in weight is out of all proportion to the actual amount of nutrient material in the milk, and this peculiarity has been remarked upon, not only when pigs are fed as indicated above, but also when pigs are fed a varied grain ration and skim milk in comparison with others on the grain ration only. Just why dairy by-products have this effect is not exactly known, but the suggestion has been made that

they keep the digestive system in better order, and thus enable the animal actually to digest a greater percentage of his feed. The same fact has been noticed when roots and green feed are fed. Pasturing on rape, alfalfa, or the grasses probably has a similar effect.

The effect of dairy by-products on the carcass is one of the most important results of such feeding. It is generally admitted that, while excellent hams and bacon may be produced without dairy by-products, the use of these by-products will result in pork of a more nearly uniform high quality.

THE FEEDING VALUE OF DAIRY BY-PRODUCTS.

Comparing grain and milk rations with rations of grain alone and milk alone.—Linfield[a] reports the results of a series of investigations at the Utah Station. In all, seven distinct experiments are given. Except in one experiment, the pigs were confined on the north side of a barn, were furnished plenty of bedding, and allowed a small run. When grain alone was fed it was mixed with water to form a thin slop, and when milk was fed with grain it was mixed in the same manner. The milk was never given sour. The hogs had access to pure water, had charcoal and ashes in the pens, and were fed twice daily. These experiments were conducted primarily with the object of comparing the value of feeding a combination of grain and skim milk with both grain alone and skim milk alone. They varied somewhat in details, and some difficulty seems to have been experienced in obtaining as much milk as the circumstances required.

The grain was fed in various combinations with the milk, and was usually that which was available in that section for feeding purposes. It consisted of equal parts of barley and bran, corn and wheat, wheat and bran, and corn meal and bran, and in two experiments ground wheat. Whey was fed in the fifth, sixth, and seventh experiments; it formed not over 12 per cent of the by-product in the fifth, but was as much as 40 per cent in the last two. It was a matter of remark that the results in these experiments were fully equal to those where skim milk was fed throughout the entire feeding period, which shows that whey has quite a high feeding value.[b] The quantity of skim milk in the lots fed milk and grain in comparison with grain alone or milk alone varied from 4 to 6 pounds of milk per pound of grain fed at the beginning of the experiment, the amount of milk being gradually decreased with the age and weight of the pigs. The pigs used were well bred, usually being Berkshires, Berkshire grades, or Poland China grades. The following table is a summary of these experiments.

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[a] Bul. No. 57.

[b] See Ontario Agricultural College experiments with sweet and sour whey, pp. 147, 148.

Economy of skim-milk feeding.[a]

Ration.	Number of tests.	Number of pigs.	Average weight at beginning.	Average gain.	Number of days fed.	Average daily gain.
			Pounds.	*Pounds.*		*Pounds.*
Milk and grain	8	27	40	169	133	1.27
Grain	5	15	63	110	121	.91
Milk	4	11	39	74	108	.68

Ration.	Feed eaten per 100 pounds gain.		Dry matter per 100 pounds gain.	Digestible dry matter per 100 pounds gain.	100 pounds milk equal pounds gain.	Average amount feed eaten per day.	
	Grain.	Milk.				Grain.	Milk.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Milk and grain	292	768	334	258	23.2	3.73	9.74
Grain	470	.....	421	319	.....	4.41	.....
Milk	.....	3,312	298	285	14.2	.....	22.28

[a] Bul. No. 57, Utah Expt. Sta.

These results indicate that, in rate of gain, an average of eight tests with a grain-and-milk ration shows gains made one-third faster than in five tests with grain alone, and nearly twice as rapidly as in four tests with milk alone. The least amount of dry matter required for 100 pounds of gain was that with the pigs on milk alone, but the pigs on grain and milk required the least digestible dry matter per 100 pounds gain. The returns from skim-milk feeding are estimated by Linfield at 17 cents per 100 pounds of skim milk when grain and milk were fed and 10 cents per 100 pounds of skim milk when milk alone was fed, grain being valued at 75 cents per 100 pounds.

These experiments show that pigs fed on grain and milk are enabled to eat much more feed than those on grain alone; those on grain and milk ate 4.24 pounds of dry matter per head daily; the pigs on grain alone 3.93 pounds of dry matter per head daily, and the daily average of the pigs on milk alone was only 2 pounds of dry matter. This is a point of great importance, and, with the figures showing rate and economy of gains, illustrates the fact that skim milk fed to pigs with grain enables them to eat more feed and to make more gain than pigs on grain alone.

The unsatisfactory character of the gains made by the pigs on skim milk alone is very apparent. This method of feeding should never be resorted to.

Corn and dairy by-products.—At the Tennessee Station Soule and Fain[a] fed four lots of pigs to compare a corn-meal and water ration with others, in which skim milk and whey were used. The pigs were high-grade Chester Whites and were confined in pens. The rations were as follows: Lot I was fed 6 pounds of corn meal and 10 pounds of water at the beginning of the experiment, increasing to 8 pounds of corn meal and 16 pounds of water toward the close. Lot II had 6

[a] *Vol.* XV, Bul. No. 1.

pounds of corn meal and 18 pounds of skim milk at the beginning, increasing to 8 pounds of corn meal and 40 pounds of skim milk toward the close. Lot III had 4 pounds of corn meal and 12 pounds of skim milk for the first fifteen days and 1.75 pounds of wheat meal, 6.25 pounds of corn meal, and 40 pounds of whey toward the close. Lot IV was fed 2.66 pounds of corn meal, 4 pounds of cowpea hay, and 8 pounds of skim milk at the beginning, which was changed to 5.5 pounds of corn meal, 1.5 pounds of chopped cowpea hay, and 26.75 pounds of skim milk toward the close.

These rations were the amounts of feed that each lot received at a single feed, so that the daily ration for one lot of pigs was double the amounts given above. The feeds were valued as follows: Corn meal, $17 per ton; pea hay, $13.50 per ton; wheat meal, $25 per ton; skim milk, 22 cents per 100 pounds; whey, 11 cents per 100 pounds. The results were as follows:

Economy of skim-milk feeding.

Ration.	Number of pigs.	Total gain.	Number of days fed.	Average daily gain.	Total dry matter eaten.	Dry matter per 100 pounds gain.
		Pounds.		*Pounds.*	*Pounds.*	*Pounds.*
Corn meal	3	186	60	1	775	416
Corn meal and skim milk	3	414	60	2.3	1,213	293
Mixed grain, skim milk, and whey	3	402	60	2.2	1,090	271
Corn meal, cowpea hay, and skim milk	2	246	60	2.0	1,017	414

Ration.	Total cost of feed.	Cost of feed per 100 pounds gain.	Net profit.[a]	Slaughter test.	
				Dressed weight.	Intestinal fat.
	Dollars.	*Dollars.*	*Dollars.*	*Per cent.*	*Pounds.*
Corn meal	7.39	3.90	7.69	73.6	13
Corn meal and skim milk	17.61	4.20	12.06	78.5	16
Mixed grain, skim milk, and whey	13.84	3.40	14.89	76.2	16
Corn meal, cowpea hay, and skim milk	12.97	5.20	4.12	77.7	9

[a] Value of manure and cost of care and feed considered.

The pigs were bought on the Knoxville market at 4½ cents per pound and weighed from 130 to 140 pounds at the time of purchase. They were sold at 5½ cents per pound.

The great advantages to be gained by feeding dairy by-products with carbonaceous concentrates are brought out in the results. The pigs on corn meal alone ate less than any others, and although their cost of feed was low they were not so profitable as those fed milk and grain, which ate very much more. An exception to the general rule is seen in Lot IV, which were fed very unprofitably.

With the pigs selling at 5½ cents per pound live weight, the authors estimate that this experiment returned, for the corn fed, 66.7 cents per bushel of 56 pounds, which is said to be 26.7 cents per bushel more than Tennessee farmers usually get for their corn. The feeding value of skim milk in this test was, approximately, 28.3 cents per 100 pounds

During the two years following the above experiment Soule and Fain[a] studied the value of skim milk in a corn-meal ration and in a mixed-meal ration. The pigs of the first year were of Chester White and Berkshire blood, some being Chester grades and others said to be Chester White-Berkshire crosses. They were above the average in quality. Those of the second year were Berkshire grades, below the average of the preceding year. The pigs were confined in pens and fed twice daily. Feeding was carried on through the winter. The first winter "was cool and bracing and uniformly dry;" the second "was raw and damp, with an excessive rainfall, and this no doubt had an influence on the general health of the hogs."

The lots which were used to compare a straight corn-meal ration with a corn-meal and skim-milk ration received, respectively, rations of corn meal only and corn meal and milk in the proportion of 1 to 8 by weight at the start, the milk being decreased toward the close so that the proportion of meal to milk was about 1 to 7.

Corn meal was charged at $28 per ton during the first year and at $19 per ton during the second year. Skim milk was charged at $4 per ton during both years.

The following table shows some of the results of this investigation. The findings of the two years were averaged, from which average these figures are taken:

Economy of skim-milk feeding.

Ration.	Number of pigs.	Total gain.	Average daily gain.	Total feed eaten.	
				Grain.	Milk.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Corn meal	7	119	0.50	489	.....
Corn meal and skim milk	7	309	1.35	481	3,686

Ration.	Feed per 100 pounds gain.		Total cost of feed.	Cost of feed per 100 pounds gain.	Profit per group.[a]
	Grain.	Milk.			
	Pounds.	*Pounds.*	*Dollars.*	*Dollars.*	*Dollars.*
Corn meal	410	.....	5.75	5.80	1.05
Corn meal and skim milk	160	1,190	12.95	4.60	4.96

[a] Value of manure and cost of care not considered.

The favorable results from the feeding of skim milk with corn meal are very noticeable in these results. Although the addition of skim milk added to the cost of the total feed and the feed per 100 pounds gain was accordingly higher, the profit for the pigs on skim milk was $3.91 more than that of those on corn alone.

Value of skim milk in a mixed ration.—As part of the investigation of the years just mentioned, Soule and Fain[a] studied the value of

[a] Vol. XVI, Bul. No. 3, Tennessee Expt. Sta.

skim milk in various proportions with a mixed ration of corn meal and wheat meal or corn meal and soy-bean meal. The proportions of these grains was 1 part of wheat or soy-bean meal to 2 parts of corn meal. The following prices per ton were charged for the feed:

	First year.	Second year.
	Dollars.	*Dollars.*
Corn and wheat meal	29	2
Corn and soy-bean meal	33	3
Corn meal	28	19
Skim milk	4	4

The conditions were those described in the foregoing paragraph. The following table shows some of the results of the averages for the two years as published by the station:

Value of skim milk in a mixed-grain ration.

Ration.	Number of pigs.	Total gain.	Average daily gain.	Total feed eaten.	
				Grain.	Milk.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Grain 1 / Milk 3	7	314	1.35	682	2,046
Grain 1 / Milk 6	7	306	1.30	590	2,060
Grain 1 / Milk 8	7	304	1.30	487	3,698
Grain 1 / Milk 9	7	331	1.40	517	4,654
Grain 1 / Milk 12	7	320	1.40	436	5,228
Grain 1 / Milk 8	[a] 7	307	1.30	491	3,731

Ration.	Feed per 100 pounds gain.		Total cost of feed.	Cost of feed per 100 pounds gain.	Profit per group.[b]
	Grain.	Milk.			
	Pounds.	*Pounds.*	*Dollars.*	*Dollars.*	*Dollars.*
Grain 1 / Milk 3	220	650	12.46	4.40	7.63
Grain 1 / Milk 6	190	1,160	14.35	5.10	5.27
Grain 1 / Milk 8	160	1,220	13.54	4.80	4.13
Grain 1 / Milk 9	160	1,410	15.07	5.10	5.82
Grain 1 / Milk 12	140	1,640	15.83	5.30	4.77
Grain 1 / Milk 8	[a] 160	1,220	14.49	5.10	3.38

[a] The grain to this lot was corn meal 2 parts, soy-bean meal 1 part. That to all the other lots was corn meal 2 parts, wheat meal 1 part.

[b] Value of manure and cost of care not considered.

The most economical ration is seen to be one in which the proportion of grain to skim milk was as 1 to 3. Beyond a certain point, it was found to be expensive to give the pigs a large amount of skim milk. However, all the lots receiving the dairy ration made good gains; the only one of the two years' tests which made an extremely poor showing was that on corn meal alone.

Skim milk compared with nitrogenous concentrates.—In order to compare the value of skim milk as a balance with that of a mixture of gluten and linseed meals Patterson[a] fed two lots of pigs of 6 each at the Maryland Station. Lot I received a ration as follows: Hominy chop, 300 pounds; ground corn fodder (new corn product), 100 pounds; skim milk, 2,400 pounds. Lot II received: Hominy chop, 300 pounds; ground corn fodder, 100 pounds; King gluten meal, 100 pounds; and linseed meal, 200 pounds. The grain was fed as a slop. Results were as follows:

Skim milk compared with nitrogenous concentrates.

Ration.	Average weight at beginning.	Average gain.	Number of days fed.	Average daily gain.	Feed eaten per 100 pounds gain.		Nutritive ratio.
					Grain and fodder.	Milk.	
	Pounds.	*Pounds.*		*Pounds.*	*Pounds.*	*Pounds.*	
Grain, fodder, and milk	66	187	121	1.54	300	1,272	1:3.52
Grain and fodder	57	136	121	1.12	407	.....	1:3.61

This experiment seems to bear out the contention that skim milk has more value as a feed than is indicated by the digestible nutrients it contains. The use of milk effected a saving of practically 25 per cent of grain in the feed required for 100 pounds of gain. The rations fed were identical in nutritive ratio, and they were made up of the same feeds, except that one was balanced with skim milk and the other with gluten and linseed meals. The great difference between the feeding values of the two rations must be ascribed to the effect of skim milk on the digestive system, and it would seem that a ration may be balanced in other ways than by the addition of certain proportions of nutrients with certain fuel values—a "balanced ration" being regarded as the one that gives the best results when fed for a certain purpose.

A comparison of skim milk and green clover in a pig's ration.—At the Maryland Station, Patterson,[a] fed two lots of Duroc Jersey and Berkshire grades of 6 pigs each on rations, one of which was balanced with skim milk and the other included cut green clover instead of milk. The grain was corn-and-cob meal, 8 parts, and 1 part each of gluten meal and linseed meal. The clover was given only in such

[a] Bul. No. 63.

amount as the pigs would eat. It was not possible to get them to eat enough to balance the ration completely. The feeding period lasted one hundred and sixty-five days.

Skim milk compared with green clover for pigs.

Ration.	Average weight at beginning.	Average gain.	Average daily gain.	Feed eaten per 100 pounds gain.			Digestible dry matter per 100 pounds gain.	Nutritive ratio.
				Grain.	Milk.	Clover.		
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Grain and skim milk	46.3	207.5	1.26	377	1,470	.....	405	1:4
Grain and clover	47.1	99.30	.60	747	.....	145	555	1:5.4

This experiment does not show profitable results from the feeding of green clover as compared with skim milk. The returns for the green clover are not at all satisfactory, very much less so than the results of other tests that have been made.

Corn meal and a mixture of corn meal and middlings in a skim-milk ration.—Clinton[a] reports the results of four years' experimenting at the Cornell University Experiment Station to study the value of certain proportions of skim milk to grain in the ration and the relative value of corn meal and a mixture of corn meal and wheat middlings in such a ration. In two experiments the best results were obtained when the ratios of grain to milk were as 1:3 and 1:2.5; in the other two the best results were with a ration in which the ratios of grain to milk were as 1:6.7 and 1:6.2. There were 133 hogs fed in these tests. The following table has been compiled from the results, and shows the feed required for 100 pounds gain for the two feeds:

Economy of skim-milk feeding.

Ration.	Number of tests.	Number of pigs.	Feed required for 100 pounds gain.	
			Grain.	Milk.
			Pounds.	*Pounds.*
Corn meal and milk	17	81	273	1,026
Corn meal, middlings, and milk[a]	12	52	223	1,069

[a] The proportion of these feeds was 4:1 in three tests. In the fourth it was not stated.

Grain values of skim milk.—The following figures show the grain values of skim milk as obtained under various methods of feeding at Ottawa.[b] The results are combined in the following table:

[a] Bul. No. 199. [b] Bul. No. 33, Central Experimental Farm.

Grain values of skim milk.

Number of pigs.	Skim milk consumed per head daily.	Milk value of 100 pounds grain.	Kind of grain.	Grain value of 100 pounds milk.
	Pounds.	*Pounds.*		*Pounds.*
	2	183	Corn	54.64
	3	183	do	54.64
	3	354	Barley	28.24
	3	323	Mixed grain	30.96
	5.4	538	do	18.69
	5.41	534	do	18.72
	13.6	791	Frosted wheat	12.64
	15.7	699	Mixed grain	14.30
	15.7	734	do	13.62
	17.1	882	do	11.33
	17.14	882	do	11.33
	23.7	776	do	12.88
	32.41	834	do	11.99
Average		604		16.55

he average of results obtained by Danish experimenters is a value bout 600 pounds of milk for 100 pounds of grain, but the greater unt of work of this nature in America has shown a higher value skim milk. The average of nineteen trials in Wisconsin with portions of milk ranging from 1 to 9 pounds for each pound of in fed, with hogs of all ages, was that 475 pounds of skim milk e equal to 100 pounds of meal.[a] In Utah[b] Linfield found the value 00 pounds of milk in terms of grain (that is, the amount of grain laced by 100 pounds of milk) to be 23.2 and 26.3 pounds, respect-y, in two series of experiments. Grisdale[c] values milk at from -fifth to one-sixth as much as mixed grain. In all experiments large return where the proportion of milk to grain is small is par-larly noteworthy. Milk should never be given to pigs in unlimited unts except while with the sow, or immediately after weaning, up he weights of 75 or 100 pounds. At this early age, much grain disarrange the digestion and best results can be expected from a on that is largely milk.

rain required for 100 pounds gain when feeding skim milk and in as compared with grain alone and milk alone.—The following le is adapted from one compiled by Linfield[d] from the results of ious stations for the purpose of showing the cost in grain of feed-rations of grain and skim milk, grain alone, and skim milk alone.

[a] Henry: Feeds and Feeding, p. 572.
[b] Bul. No. 57.
[c] Bul. No. 33, Central Experimental Farm.
[d] Bul. No. 57, Utah Expt. Sta.

Feed per 100 pounds gain.

Station.	Dry matter for 100 pounds gain.		
	Grain and milk.	Grain alone.	Milk alone.
	Pounds.	*Pounds.*	*Pounds.*
Wisconsin	345	455	189
Colorado	298	576	.....
New Hampshire[a]	231	334	.....
Utah[a]	334	421	198
	258	319	165

[a] The results in New Hampshire and the second line of Utah results show estimated digestible dry matter.

These figures show what can be regarded as representative values of these three methods of feeding, and emphatically demonstrate the onomy of the grain-and-milk combination. Linfield calls attention the fact that none of the pigs fed milk alone attained a weight of over 100 pounds, whereas some of those in the other columns reached nearly 300 pounds. It does not always mean profitable feeding for a hog to require a small amount of feed to make a certain gain.

Value of milk at various prices for grain.—Using as a basis the results obtained in the investigations already mentioned, Linfield[a] makes the following estimates of the value of skim milk as a supplementary feed in a ration at various prices for grain:

Value of skim milk for pigs.

Ration.	Number of pigs.	Grain equal to 100 pounds skim milk.	Value of skim milk per 100 pounds when grain is worth, per 100 pounds—						
			40 cents.	50 cents.	60 cents.	70 cents.	80 cents.	90 cents.	$1.
		Pounds.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Milk and grain.	27	23.2	9.3	11.5	13.9	16.2	18.6	20.9	23.2
Milk	11	14.2	5.7	7.1	8.5	9.9	11.4	12.8	14.2

A similar study was made by Lindsey[b] and others from the results at the Hatch Station, except that the figures do not include the results of feeding on milk alone. The averages of their experiments are given in the following table. "Starchy feeds" refer to such substitutes for corn meal as hominy meal, cerealine feed, rye meal, wheat meal, etc.; "other grains" are the nitrogenous feeds, such as wheat bran, gluten meal, linseed meal, etc.:

[a] Bul. No. 57, Utah Expt. Sta. [b] Eleventh An. Rpt., Hatch Expt. Sta.

Value of skim milk for pigs.

ost of feed—	With dressed pork at 5 cents per lb., skim milk is worth—		With dressed pork at 6 cents per lb., skim milk is worth—		With dressed pork at 7 cents per lb., skim milk is worth—	
	Per quart.	Per 100 pounds.	Per quart.	Per 100 pounds.	Per quart.	Per 100 pounds.
	Cent.	*Cents.*	*Cent.*	*Cents.*	*Cent.*	*Cents.*
neal and other starchy $15 per ton, "other t $17.50 per ton.....	0.50	23.07	0.67	30.73	0.88	38.19
neal and other starchy $17.50 per ton, "other t $20 per ton	.45	20.66	.61	28.14	.78	35.86
neal and other starchy $20 per ton, "other t $22.50 per ton.....	.39	18.08	.56	25.82	.78	35.70

f feed when feeding skim milk.—The following shows the cost per 100 pounds of live and dressed weight produced as esti- rom the Massachusetts[a] experiments at various prices for id milk :

Cost of feed per 100 pounds of growth produced.

Cost of feed—	Cost per 100 pounds live weight.	Cost per 100 pounds dressed weight.
	Dollars.	*Dollars.*
meal at $15 per ton, "other grains" at $17.50 per ton, and milk at r quart	2.78	3.47
meal at $15 per ton, "other grains" at $17.50 per ton, and milk at quart	4.00	4.99
meal at $17.50 per ton, "other grains" at $20 per ton, and milk at r quart	3.04	3.79
meal at $17.50 per ton, "other grains" at $20 per ton, and milk at r quart	4.25	5.31
meal at $20 per ton, "other grains" at $22.50 per ton, and milk at r quart.....	3.63	4.53
meal at $20 per ton, "other grains" at $22.50 per ton, and milk at r quart	4.51	5.63

abor cost of feeding.—In experiments in pork production ators almost invariably disregard the expense of care and stimating that this will be covered by the value of the manure id the saving in expense of marketing crops. This is always

[a] Eleventh An. Rpt., Hatch Expt. Sta.

more or less of an obstacle in applying the results of experiments to actual farming conditions, for the manure is not always carefully saved on the farm. Linfield,[a] of the Utah Station, studied the labor cost as shown by the experience of some of the creameries in his State that were feeding large numbers of hogs, and states the result of his inquiries as follows:

> One creamery reports that one man would feed 1,000 hogs, clean all the pens each day, and draw the grain feed from the mill 2 miles distant. Another says that one man does all the work of feeding and cleaning out the pens for 500 hogs in five hours each day. The wages paid in each case was about $1 per day.
>
> At both creameries the hogs are purchased when weighing from 50 to 100 pounds each, though some few are heavier. The hogs are crowded from the start, and at most not more than 100 days are required to fit the hogs for market, and in this time 100 to 125 pounds have been added to the live weight of each hog.
>
> By putting all of the above figures together we find that it costs five hours' labor or 50 cents to look after 500 hogs for one day, or $50 to look after 500 hogs for one hundred days. This is 10 cents for 1 hog for one hundred days, or for 100 pounds gain, which gives one-tenth of a cent as the labor cost of producing 1 pound of live weight of hog. It is thus evident from the results of these practical men that when handled in large numbers, as hogs may be at a creamery, the labor is a very small item in growing the hogs. If the value of the gain was reckoned at 4 cents per pound the labor cost of producing the pork was but 2½ per cent of its selling price.

Lest these results be misleading, Linfield calls attention to the fact that the conditions were almost ideal for the greatest economy, the hogs were "short fed," and all feeding appliances and pens were so arranged as to have in view the greatest possible saving of labor. At another creamery, where the hogs were raised on the place and fed until they were fifteen months old and the accommodations were not so good, the cost reported was as large for 300 hogs as the others reported for 1,000 head. It is pointed out that, on the average farm, where the number of animals is much smaller, and milk must usually be hauled back to the farm, the labor cost will be very much greater.

Skim-milk rations for growing pigs.—The Hatch Station[b] recommends the following rations for pigs weighing from 20 to 180 pounds when the feeder has an unlimited supply of skim milk at hand:

Rations for growing pigs.

Weight of pigs.	Rations.
20 to 60 pounds.....	3 ounces of corn meal to each quart of milk.
60 to 100 pounds.....	6 ounces of corn meal to each quart of milk.
100 to 180 pounds.....	8 ounces of corn meal to each quart of milk.

[a] Bul. No. 57. [b] Eleventh An. Rpt.

The following rations may be used where the milk supply is in limited amounts:

Rations for growing pigs.

Weight of pigs.	Rations.
20 to 180 pounds	3 ounces of corn meal, wheat, rye, or hominy meals to each quart of milk, and then gradually increase meal to satisfy appetites.
20 to 60 pounds	Milk at disposal, plus mixture of one-third corn meal, one-third wheat bran, and one-third gluten meal to satisfy appetites.
60 to 100 pounds	Milk at disposal, plus mixture of one-half corn meal, one-fourth wheat bran, and one-fourth gluten meal to satisfy appetites.
100 to 180 pounds	Milk at disposal, plus mixture of two-thirds corn meal, one-sixth wheat bran, and one-sixth gluten meal to satisfy appetites.
20 to 60 pounds	3 ounces of corn meal to each quart of milk, and 4 ounces of gluten feed as a substitute for quart of milk.
60 to 100 pounds	Milk at disposal, and mixture of one-half corn meal and one-half gluten feed to satisfy appetites.
100 to 180 pounds	Milk at disposal, and mixture of two-thirds corn meal and one-third gluten feed to satisfy appetites.

Sweet compared with sour whey.—At the Ontario Agricultural College, Day[a] conducted five experiments to compare the feeding values of sweet and sour whey. Each experiment was preceded by a preliminary period of from one to two weeks and the experiments proper varied in duration from twenty-nine to sixty-four days. In each one as a check a group of pigs was fed on meal only mixed with water. The group receiving whey had it mixed with the grain, and both lots received the same quantity of whey, which was about 2 pounds to each pound of meal. All lots had as much feed as they would eat readily. The sour whey fed in 1897 "was kept in a tank which had not been cleaned since early in the summer of 1896." The meal was a mixture of equal parts of pease, barley, and oats.

The following table shows the amount of grain saved by feeding whey for each experiment and for the average:

Grain saved by feeding sweet and sour whey.

Experiment.	Amount of meal saved by 100 pounds of sweet whey.	Amount of meal saved by 100 pounds of sour whey.
	Pounds.	*Pounds.*
No. 1 (1896)	13.32	13.61
No. 2 (1896)	13.32	13.81
No. 3 (1897)	14.88	7.87
No. 4 (1897)	No test.	10.07
No. 5 (1897)	6.08	9.34
Average	11.90	10.94

[a] An. Rpts., 1896 and 1897.

Whey feeding is often attended with difficulty, as it causes a stiffening of the joints and serious lameness. This condition occurred in the experiments of 1896; and in 1897 the group fed sweet whey in experiment No. 4 was so seriously checked by this trouble that they were left out of the comparison. Day calls particular attention to the fact that the lots receiving sour whey were not at all affected.

If experiment No. 4 is omitted in the preceding table, the average amount of meal saved by 100 pounds of sour whey is 11.15 pounds. The value of whey in pork feeding is, according to these figures, about half that of skim milk.

The following shows the results of six analyses of whey made during these experiments by the chemical department of the Ontario Agricultural College:

Composition of whey.

	Sweet whey.	Sour whey.
	Per cent.	*Per cent.*
Nitrogenous matter	0.920	0.973
Sugar	4.709	.083

Day suggests that the higher percentage of nitrogenous substances in the sour whey was perhaps due to evaporation of the original samples.

PASTURE AND PASTURE SUBSTITUTES.

PASTURE.

Value of pasture with a grain ration.—The Utah Station[a] has devoted considerable study to the effect and value of pasture for pigs that are on a grain ration. The pastures used were made up of mixed grasses and alfalfa. The Utah problem in pork production is defined as the use of "a minimum amount of grain and a maximum amount of alfalfa, milk, and whey, or other cheap foods." The following table shows the results of four seasons' study of this problem, where rations of grain and pasture and grain alone were compared:

Value of pasture with grain.

Ration.	Feed eaten daily.	Total gain.	Average daily gain.	Feed eaten per 100 pounds gain.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Grain and pasture	4.72	247	1.21	386
Grain	4.05	185	.94	430

These results strongly favor the use of pasture when feeding pigs under conditions similar to those that exist in Utah. In every respect the pigs on pasture show better results than those that had no pasture; the total gain per head averaged 33 per cent greater for the

[a] Bul. No. 70.

pigs on pasture than for those on grain alone; the average daily gains were nearly 29 per cent greater, and there was a saving of more than 10 per cent in the feed per 100 pounds gain for the pigs on pasture.

Value of a grain ration with pasture.—The converse of the Utah experiments is shown by two experiments by Morrow and Bone[a] in Oklahoma.

Two lots of 4 pigs each were placed in half-acre alfalfa lots, one being given a full feed of grain and the other receiving none. In eight weeks the lot without grain had gained only 68 pounds, or 17 pounds each, and those having grain gained 324 pounds, or 81 pounds each.

A sow with a litter of 5 pigs was in the same lot with the grain-fed pigs. The sow gained 61 pounds in thirty-five days, when she was removed. Her 5 pigs made a total gain of 146 pounds in the first five weeks and 96 pounds during the succeeding period of three weeks. The grain fed these pigs amounted to only 221 pounds per 100 pounds gain.

Pasture in addition to dairy by-products.—Four tests were made in Utah[b] to determine the value of pasturing pigs that are receiving a ration of grain, milk, and whey. One test was made with pasturing pigs that were receiving milk and whey, but no grain. The ratio of milk to grain by weight was 5:1 at the start and 3:1 at the close in the second and third tests. In the fourth test the grain was limited to one-half the quantity fed the other lots, but all the milk and whey was given that the pigs would take.

The pigs that received the grain and dairy by-product ration were fed in pens.

The following table shows the results for each test and the average of all:

Value of pasture with dairy by-products.

Ration.	Total gain.	Average daily gain.	Feed eaten daily.		Feed per 100 pounds gain.	
			Milk.	Grain.	Milk.	Grain.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Milk[a] and pasture	218	0.69	21.00	.....	3,034	.....
Milk	202	.64	23.54	.....	3,672	.....
Milk, grain, and pasture	350	1.11	9.56	3.34	859	300
Milk and grain	366	1.16	10.71	3.13	921	269
Milk, grain, and pasture	324	1.25	10.11	3.38	805	269
Milk and grain	351	1.35	11.52	3.24	879	238
Milk, grain, and pasture	273	1.05	15.65	1.09	1,479	139
Milk and grain	284	1.10	18.12	1.62	1,837	147
Average with pasture	291	1.03	14.08	2.60	1,544	236
Average without pasture	301	1.06	15.97	2.66	1,827	218

[a] By "milk" is meant both milk and whey.

The results of the first test bear out previous experience with attempts to make pork on pasture without grain, although the gains

[a] An. Rpt. *1898–99, Oklahoma Expt. Sta.* [b] Bul. No. 70, Utah Expt. Sta.

given are fairly good and better than might be expected on a pasture containing only a small amount of alfalfa. The addition of skim milk did not prove beneficial in anyway. In the experiments where grain was fed no advantage accrued through the use of pasture, except that the pasture lots consumed nearly 300 pounds less milk per 100 pounds gain than those in pens. At 15 cents per 100 pounds, this means a difference of 45 cents per 100 pounds of pork made. The difference in grain fed was nearly 20 pounds per 100 pounds of pork made in favor of the pen-fed lots.

These results are evidence in support of the idea that the effect of dairy by-products and succulent feed in the ration is similar, and that to get the greatest amount of gain at the least expenditure of feed only one of the supplementary feeds is necessary; that the addition of pasture to a ration which already contains a large amount of dairy by-products is superfluous; and that the only advantage to be gained by such a method of feeding is the exercise obtained by the pigs on pasture.

Pen compared with pasture feeding.—At the Utah Station, Linfield[a] fed six lots of 3 pigs each, in two tests, to study the value of rations composed of grain and milk, grain alone, and milk alone. Both tests were conducted during the summer and fall of the same year. In one test the pigs had the run of a pasture of mixed grasses in which was a large amount of alfalfa. The following table shows a comparison between pen and pasture feeding:

Pen compared with pasture feeding.

Method of feeding.	Average daily gain.	Dry matter per 100 pounds gain.	Estimated digestible dry matter per 100 pounds gain.	Dry matter eaten per day.
Lots fed on milk:	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
On pasture	0.7	256	261	1.79
In pen	.65	310	275	2
Lots fed on milk and grain:				
On pasture	1.12	319	261	3.58
In pen	1.17	320	262	3.75
Lots fed on grain:				
On pasture	.81	355	268	4.35
In pen	.51	443	334	2.28

The only pigs that showed better results in pens than on pasture were those on grain and milk. Those receiving grain alone on pasture gave very much larger gains, required less feed per 100 pounds gain, and ate more feed than those receiving grain alone in pens. Linfield suggests that either the exercise or the feed obtained by the run on pasture gave these pigs greater appetite and enabled them to digest a greater amount of feed daily. The fact that neither of

[a] Bul. No. 57.

the other lots showed a marked advantage from pasture might be explained by the skim milk in the ration. It is perhaps a safe proposition that in feeding pigs the best results will follow the use of dairy by-products, roots, or pasture, in connection with grain, but that it is superfluous to combine two of these supplementary feeds, as their action on the digestive system seems to be similar. When attempts are being made to prevent disease, however, the advantage of ample exercise must not be overlooked.

Corn compared with wheat on alfalfa pasture.—At the Nebraska Station,[a] Burnett and Smith placed three lots of 6 pigs each on alfalfa pasture lots one-fourth acre in area. The pigs were Tamworth-Duroc Jersey crossbreds. Lot I was fed ground corn; Lot II, a ration composed of 95 per cent ground corn and 5 per cent dried blood, and Lot III received ground wheat. In addition to the pasture, all the pigs had one week on rape. The experiment lasted forty-two days. The results follow:

Corn compared with wheat on alfalfa pasture.

Ration.	Number of pigs.	Average weight at beginning.	Average weight at close.	Average gain.	Average daily gain.	Average amount feed eaten.	Feed per 100 pounds gain.	Cost per 100 pounds gain.	Profit per lot.[a]
		Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Dolls.*	*Dolls.*
Ground corn	6	146	223	77	1.22	308	400	4.00	3.77
Ground corn 95 per cent. Dried blood 5 per cent	6	145	227	82	1.30	308	376	4.04	3.88
Ground wheat	6	147	229	82	1.30	308	376	4.13	3.83

[a] Expense of pasture and labor considered.

The cost of feed in this experiment was, for corn, $1 per hundredweight; wheat, $1.10 per hundredweight, and dried blood, $2.50 per hundredweight. The results are so close together that a slight change in the prices of feed would change the relative rank of these rations. The value of pasture is apparent when these results are compared with those of the experiment at this station with wheat and other grains. (See p. 98.)

Maintaining pigs on pasture alone.—At the Utah Station Foster and Merrill[b] conducted two tests to observe the effect of maintaining pigs on pasture alone.

According to Henry,[c] no station has shown that pigs can be successfully maintained on pasture alone if the test reported from the Utah Station is excepted. The further investigations at this station on this line are therefore of much interest.

In 1898 a comparison was made of mixed pasture and alfalfa pasture. The pigs were about five months old at the beginning of the test, had been fed grain and milk, and were in a very thrifty condition. Both lots had access to running water.

[a] Bul. No. 75. [b] Bul. No. 70. [c] Feeds and Feeding, pp. 578, 579.

The experiment in 1899 was in some ways a continuation of that of 1898. Two lots of pigs were used; both were on alfalfa pasture, but they differed in age. Lot I consisted of 3 pigs about four months old, and Lot II of 3 pigs about seven months old and nearly twice as heavy as those in Lot I. The following table gives the results of the experiments:

Pigs on pasture without grain or milk.

Ration.	Number of pigs.	Total weight at beginning.	Total weight at close.	Total gain.	Number of days fed.	Average daily gain.
1898.		*Pounds.*	*Pounds.*	*Pounds.*		*Pound.*
Lot I. Mixed pasture		251	321	70	125	0.56
Lot II. Alfalfa pasture		284	280	[a]4	109	.022
1899.						
Lot I. Alfalfa pasture	3	165	188	23	129	.059
Lot II. Alfalfa pasture	3	330	322	[a]8	110	.064

[a] Loss.

These experiments do not change one's opinion regarding the value of pasture alone for pigs. The two lots gained in weight—one on mixed pasture and the other on alfalfa pasture. The effect of this method of feeding on the appearance of the pigs was very marked; in the 1898 test this was particularly commented upon. "The plump rounded forms gave place to large coarse frames and large stomachs. At the end of the experiment they looked very much larger than at the beginning, but the scales failed to show any gains. What is said above would also apply to the mixed pasture set, only in that case the eye was not so badly deceived—small gains were made."

In 1899 pigs that were receiving small amounts of feed, either milk or grain in addition to pasture, were found to have made gains very nearly in proportion to the amount of extra feed given, which Foster and Merrill regard as evidence that the pasture supplied enough feed for maintenance only.

GREEN SUBSTITUTES FOR PASTURE.

Pasturing on rape.—At the Utah Station Foster and Merrill[a] pastured 6 pigs on a plot of rape that had been seeded August 11, after having been irrigated and plowed. The pigs were hurdled in pens 16 feet square and without shelter from rain or snow. They received a ration of 1 pound daily of a mixture of equal parts of bran and chopped wheat.

At the Canada Central Experimental Farm, Grisdale[b] pastured 6 pigs on a plot three-sixteenths acre in extent that had been drilled to rape, the drills being 30 inches apart. These pigs received a daily

[a] Bul. No. 70. [b] An. Rpt., 1900.

grain ration of 1 pound per head at the beginning, which was increased to 5 pounds at the close. At the Alabama Station, Duggar[a] hurdled pigs, which had been weaned three weeks, on rape drilled on sandy upland the previous October. They received about a half ration of corn meal in addition.

The results are as follows:

Pasturing on rape.

Where fed.	Number of pigs.	Total weight at beginning.	Total gain.	Number of days fed.	Average daily gain.	Grain eaten.	Grain per 100 pounds gain.
		Pounds.	*Pounds.*		*Pounds.*	*Pounds.*	*Pounds.*
Utah	6	296	60	49	0.204	294	490
Canada	6	358	869	114	1.27	2,067	238
Alabama	4	130	181	81	.56	524	290

At the close of the Alabama test, the pigs were placed on second-growth rape for three weeks. They grazed one-sixth acre, eating 168 pounds corn meal and making a gain of 82 pounds, which was an average daily gain of 0.98 pound, at a cost of 205 pounds meal for 100 pounds gain. Assuming that 500 pounds of grain alone are required for 100 pounds gain, Duggar[a] estimates the amount of the pork produced per acre from the first and second growth rape together at 512 pounds, worth at that time $20.48.

Seven shoats, averaging 41 pounds in weight, were on rape at the same station for four weeks during the late spring. They received some corn meal in addition. During the first two weeks the rape was fed to the pigs in the pens; during the remainder of the time they were hurdled. They ate 318 pounds of corn meal. The total gain in weight for the four weeks was 103 pounds, an average daily gain of 0.53 pound, 310 pounds of grain and 4,050 square feet of rape being required to produce 100 pounds of gain.

Rape compared with clover.—The Wisconsin Station[b] has reported two experiments comparing rape and clover as pasturage for hogs. In the first, 20 purebred or high-grade Poland China pigs between five and six months of age were used. Lot I was hurdled on rape, had access to water, and had the run of a blue-grass lot. Their grain feed was a mixture of 2 parts of corn meal and 1 part shorts twice daily as slop. Lot II was on a 10-acre lot of second-growth clover, and received the same grain ration as Lot I. In the second experiment the pigs used were purebred and high-grade Berkshires and Poland Chinas. Their grain ration was the same mixture as that used in the first experiment, mixed into a thick slop. Lot I was hurdled on

[a] Bul. No. 122. [b] Sixteenth and Seventeenth An. Rpts.

rape; Lot II had the run of an 8-acre field of second-growth clover. The results were as follows:

Rape compared with clover.

Ration.	Number of pigs.	Total weight at beginning.	Total gain.	Number of days fed.	Average daily gain.	Grain eaten.	Grain per 100 pounds of gain.
		Pounds.	*Pounds.*		*Pounds.*	*Pounds.*	*Pounds.*
Grain and rape	20	2,111	1,043	63	0.67	4,082.75	[illegible]
Grain and rape	21	2,139	1,498	56	1.27	4,985	[illegible]
Average							[illegible]
Grain and clover	20	2,091	941	63	.78	4,082.75	[illegible]
Grain and clover	21	2,136	1,435	56	1.23	4,985	[illegible]
Average							[illegible]

These experiments give rape a greater value for pigs than clover pasture. Rape has an advantage of over 7 per cent in grain required per 100 pounds of gain.

The influence of rape on grain eaten.—At the Wisconsin Station Carlyle[a] fed two lots of pigs—one lot hurdled on rape pasture and the other fed in a roomy yard without any kind of green feed. Both lots received the same grain ration, which was a mixture of equal parts of corn meal and shorts made into a slop immediately before feeding, and had coal ashes at all times. The experiment began August 4, when the rape was about 20 inches high. The pigs used were about four months old at the beginning of the experiment, and represented the Poland China, Berkshire, and Yorkshire breeds. The following is a summary of the results:

Value of rape with grain.

Ration.	Total weight at beginning.	Total weight at close.	Grain eaten.	Total gain.	Average gain.	Average daily gain first six weeks.	Average daily gain second six weeks.	Grain per 100 pounds gain.	Cost of grain per 100 pounds
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pound.*	*Pounds.*	*Pounds.*	*Dollars.*
Lot I, without rape	1,017	2,211	5,042	1,194	70.2	0.71	1.08	427	3.73
Lot II, with rape	1,001	2,412	5,920	1,411	83	.88	1.23	420	3.36

Exclusive rape feeding.—At the Wisconsin Station Carlyle[b] fed two lots of pigs on rape alone for two weeks. Two lots of 18 pigs each were taken from rations composed of grain exclusively, grain and clover, and grain and rape. They were given nothing but rape. They fed nearly all day, appeared contented, and scoured but little, but 25 of

[a] Eighteenth An. Rpt. [b] Seventeenth An. Rpt.

the 36 lost in weight during the two weeks. They were on rape, and only 4 made gains. The total loss on 36 pigs was 60 pounds, or at the rate of $1\frac{2}{3}$ pounds per pig. The 6 pigs that had been on an exclusive grain diet lost 18 pounds, or 3 pounds each. The 8 pigs that had been on grain and clover lost 19 pounds, an average of nearly $2\frac{1}{3}$ pounds each, and the 22 pigs that were taken from a grain and rape diet lost 33 pounds, or $1\frac{1}{2}$ pounds each.

Soiling.—The Utah Station[a] reports the results of seven tests of the value of green feed to pigs in pens and yards on full grain and one-fourth grain rations. In four tests the pigs were in pens and in three they were in open yards. The green feed was mainly alfalfa, but some waste garden products were also fed.

During the first two years of these tests, embracing four experiments, the dry matter in the grass was estimated and included in the figures for feed eaten; but in the last three tests only the actual weight of grain fed was taken into account. The following table shows a summary of the results:

Value of soiling pigs on grass.

Ration.	Number of tests.	Average daily gain.	Feed eaten daily.	Feed per 100 pounds gain.
Average of all:		*Pounds.*	*Pounds.*	*Pounds.*
Full grain	7	1.04	4.42	424
Full grain and grass	7	1.13	4.74	414
One-fourth grain and grass	3	.36	2.23	659
Average of pens:				
Full grain	4	.94	4.05	442
Full grain and grass	4	1.17	4.75	402

These results show a considerable advantage in daily gains for the pigs that were soiled and a similar saving in feed. The pigs in pens show a very marked advantage for soiling. There was an average daily gain of 0.23 pound more for the soiled pigs than for those on grain alone, and the feed required for 100 pounds gain was nearly 10 per cent less. It is suggested that these good results were due as much to the healthful action of such feed on the digestive system as to their nutrient content.

The Ontario Agricultural College[b] conducted an experiment to compare pasturing on such feeds as vetches and rape with their feeding in pens. Disregarding the item of labor, these results show that soiling is very economical. The average daily consumption of feed by pigs in the pens was approximately 4 pounds of green feed and

[a] Bul. No. 70. See page 93 for explanation of "partial" and "full" grain rations.
[b] An. Rpt., 1901.

4⅓ pounds of meal. This experiment was part of a breed test, and generally the best pigs were in the outside lots. Yet the meal required for 100 pounds gain was, for all breeds, 510 pounds with the outside lots and 414 for those in the pens on grain and green feed. At the close of the experiment the pigs were sold, and the packer's report showed nothing unfavorable to the method of feeding. The bacon produced was firm and of good quality in other ways. The pigs that were soiled required twice as much time for attention and feeding as those outside.

Purslane.—Plumb[a] reports a trial in Indiana with two Chester White sows confined in small pens and fed for twenty-one days a mixture of equal parts shorts and hominy meal with all the purslane they would eat. Purslane was not eaten with the relish that was expected, but the pigs made fairly good gains at a cost of 2.2 cents per pound.

Grazing chufas.—Duggar[b] hurdled 9 Berkshire pigs from November 19 to December 17 on chufas, with some grain, and a mixture of corn meal and cowpea meal in addition. They gained 121 pounds, grazed 7,986 square feet of chufas, and ate 262 pounds of grain, thus requiring only 234 pounds of grain for 100 pounds gain. With the usual allowances for the gain due to the grain fed, the return per acre for the chufas, estimating pork at 3½ cents per pound, was $13.09.

Grazing peanuts, chufas, and soy beans.—At the Arkansas Station, Bennett[c] fed four lots of half-bred Berkshire pigs to compare the grazing values of these three crops with pen feeding on corn. The soil on which the crops were grown was a sandy loam with an estimated capacity of 30 bushels of corn per acre. The crops named were planted in rows 3 feet apart—the peanuts 14 inches apart in the rows, the chufas[d] 12 inches apart in the rows, and the soy beans drilled. The stand was estimated at 87 per cent for the peanuts, 75 per cent for the chufas, and only good for the soy beans. The corn was fed dry on the ear, and the grazing was done by using hurdles. The feeding

[a] Bul. No. 82.

[b] Bul. No. 122, Alabama Expt. Sta.

[c] Bul. No. 54.

[d] Chufas are coarse plants belonging to the sedge family. Two species are used in the manner here mentioned—*Cyperus rotundus* and *C. esculentus*. According to Gray, *C. rotundus* is found in sandy fields from Virginia to Florida and Texas, and is occasionally met with in the neighborhood of Philadelphia and New York City. *C. esculentus* is found in low grounds, along rivers, etc., from New Brunswick to Florida and west to Minnesota and Texas. This is the species more commonly used as feed for hogs.

These plants form small tubers which enable them to spread rapidly and form a thick, matted growth, each tuber being capable of producing a plant. The tubers are relished by hogs, but the plants are of questionable value, as it is almost impossible to eradicate them when once established, especially in sandy soils. Botanists do not advise planting them in soil that can be used for any other purpose.

lasted forty-six days, except for the soy beans, which gave out sooner than expected. The results were as follows:

Peanuts, chufas, and soy beans compared with corn.

Kind of feed.	Number of pigs.	Average weight at beginning.	Total gain.	Average daily gain.
		Pounds.	*Pounds.*	*Pound.*
Peanuts	4	116.5	104.5	0.57
Chufas	4	121.3	66	.35
Soy beans	3	124.75	[a]22.75	[a].24
Corn	3	139	112.3	.81

[a] Thirty-two days.

The areas of peanuts and chufas grazed were one-twelfth acre and one-ninth acre, respectively. To produce 112.3 pounds of pork with the corn-fed lot 7.6 bushels of corn were eaten. From these data the yield of pork per acre was estimated as follows:[a] Peanuts, 1,252 pounds; chufas, 592 pounds; corn, 436 pounds, estimating the corn yield at 30 bushels per acre.

The quality of the pork from pigs grazed on chufas and soy beans was about the same as that from corn-fed pigs; the peanut-fed lot produced a soft, oily quality of fat, but no deleterious results could be detected in cooking.

In the following two years Bennett[b] grazed pigs on peanuts and chufas, the results being noted below. In addition to the study of the feeding value of these plants, their effect on the quality of the pork was studied. When hogs are grazed on peanuts or chufas the lard has quite a low melting point; and, as nearly all such feeding is conducted in the Southern States, this condition gives rise to considerable trouble during the summer months. To obviate this difficulty the common practice of farmers is to use corn in finishing hogs that have had peanuts as the principal component of the ration. The results of the study of the effects of these feeds on the quality of pork are presented elsewhere in this bulletin.

Bennett's feeding results in 1899 and 1900 follow:

In 1899 Lot I grazed a crop that was alternately three rows of peanuts and one of chufas; Lot II grazed peanuts; Lot III grazed chufas; Lot IV grazed chufas; Lot V grazed as Lot I. The grazing lasted sixty days, except for Lots IV and V, which grazed ninety days. Lots III, IV, and V had no finishing period on corn. Two pigs were slaughtered in both of the first two lots at the expiration of the grazing period, the melting point of the fat determined, and the remaining pigs put on a full feed of corn. At intervals of two weeks 2 more

[a] Soy beans not estimated. [b] Bul. No. 65, Arkansas Expt. Sta.

pigs were slaughtered and the melting point of the fat determined, continuing in this manner until all the pigs were slaughtered, so that the last pigs to be slaughtered had been on corn eight weeks.

The pigs used in the 1899 experiment were natives, not over one-fourth of improved blood. They were from ten to twenty months old and averaged about 115 pounds in weight.

In 1900 the feeding was as follows: Lot I grazed on a field of alternate rows of peanuts and chufas for seventy-five days, receiving some corn in addition. Lot II grazed a field of alternate rows of peanuts and chufas for fifty days, and for twenty-five days received a quantity of corn equivalent to that fed the above lot. Lot III grazed peanuts for seventy-five days and had corn as Lot I. Lot IV grazed peanuts as above for fifty days and had corn for twenty-five days as the preceding lots. Lot V grazed on peanuts and had corn at the same time for seventy-five days. The pigs of this lot were purebred Berkshires, and were used to determine the effect of improved blood on the melting point of lard.

The quality of these pigs was somewhat higher than in the experiment of 1899. The pigs of Lots I to IV were from eight to twelve months old at the beginning; the purebred pigs were from six to eight months old.

The gains of the pigs, while incidental to the main purpose of the experiment, are of much interest. Those for 1899 are as follows:

Comparative gains in feeding pigs on peanuts, chufas, and corn.

Lot.	Number of pigs.	Average weight at beginning.	Total gain.	Number of days fed.	Average daily gain
		Pounds.	*Pounds.*		*Pounds.*
I	10	116.7	981	60	1.63
II	10	116.2	996	60	1.66
III	4	111.5	332	60	1.38
IV	2	115.5	246	90	1.37
V	2	116.5	266	90	1.47

The following gains were made during 1900:

Comparative gains in feeding pigs on peanuts, chufas, and corn.

Lot.	Number of pigs.	Average weight at beginning.	Total gain.	Number of days fed.	Average daily gain.
		Pounds.	*Pounds.*		*Pounds.*
I	4	99.5	518	75	1.72
II	4	95	482	75	1.60
III	4	96.25	535	75	1.78
IV	4	95	510	75	1.70
V	6	98	717	75	1.59

Grazing peanuts.—At the Alabama Station, Duggar[a] grazed 6 Poland China pigs on peanuts, with some corn in addition. The lot made a

[a] Bul. No. 93.

gain of 380.7 pounds in six weeks on an area of about one-sixth acre and ate 373 pounds of corn. Estimating corn at 40 cents per bushel and pork at 3 cents per pound this is a return of $18.34 per acre for peanuts from this method of feeding, somewhat less than the Arkansas experiment previously mentioned.

On a portion of the field which was not pastured the peanuts were dug and yielded at the rate of 62.6 bushels (1,565 pounds) of dry nuts per acre. From this the total feed required to produce 100 pounds gain was estimated as 140 pounds of peanuts and 190 pounds of corn—a total of 330 pounds of concentrates, with vines eaten not estimated.

Duggar estimates the value of the return from peanuts in pork at $18 per acre, and states that the same land with the same fertilizers, would not produce over 200 pounds of lint cotton per acre, which would be worth $10 or $12, with cotton at 5 or 6 cents per pound, while the expense of cultivating the cotton would be much greater.

In a later experiment Duggar[a] penned a litter of 9-weeks-old pigs on a two-thirds stand of Spanish peanuts just after weaning. They were on this pasture from November 4 to December 23, and ate 162 pounds of corn meal for 100 pounds gain in addition to grazing about five-sixths of an acre of peanuts. At 4 cents per pound for pork, and making allowances for the grain eaten, the return per acre for the peanuts was $10.04.

In another test[a] a sow and her litter of 9 pigs were fed from September 30 to November 4 on corn meal, skim milk, and Spanish peanuts from one-fourth acre of land. They ate 355 pounds of corn meal and 921 pounds of skim milk. The sow and pigs gained a total of 236 pounds. At 4 cents per pound for pork, valuing corn meal at $1 per 100 pounds and skim milk at 25 cents per 100 pounds and estimating 325 pounds of skim milk to be worth 100 pounds corn meal, the return per acre for the peanuts was $17.28.

In another test[a] 7 shoats, averaging nearly 100 pounds, were penned on Spanish peanuts from October 11 to November 2 and fed some corn meal. They made a total gain of 225 pounds, eating 286 pounds of corn meal and grazing the peanuts on 0.47 acre, requiring only 127 pounds of corn meal for 100 pounds gain. With the usual allowances, the return per acre for the peanuts in this test was $18.02.

In another test[a] 7 shoats were taken from corn meal, cowpea meal, and sorghum and placed on Spanish peanuts and corn meal for four weeks. They ate 333 pounds of corn meal and grazed 10,593 square feet of peanuts, making a gain of 121 pounds, which was at a cost of 273 pounds grain for 100 pounds gain. The value per acre of the peanut pasture was estimated, by the usual method, at $9.

Some of these pigs were continued by hurdling on peanut pasture and were given some grain in addition for five weeks longer. In this period the return per acre for the peanuts was estimated at $9.88.

[a] *Bul. No. 122*, Alabama Expt. Sta.

In another test[a] a litter of 7 Poland China pigs, averaging 28 pounds in weight, were hurdled on Spanish peanuts just after weaning. The pasturing continued six weeks and no grain was fed. The total gain was 157 pounds, an average daily gain of 0.53 pound. The area grazed was 13,887 square feet, and the return per acre, with pork at 4 cents per pound, was $20.12.

Peanut pasture compared with corn meal.—The Alabama Station[a] fed one lot of pigs on a peanut field which was a poor stand, giving some corn meal additional; another lot had nothing but the peanut pasture, and a third lot corn meal only. There were 3 pigs in each lot, and they were of rather ordinary feeding qualities. In four weeks the lot on peanuts and corn meal gained 38.6 pounds, those on peanuts alone gained 21.1 pounds, and those on corn meal lost 5.1 pounds. The lot on peanuts and corn meal ate 206 pounds of corn per 100 pounds gain and grazed 2,025 square feet planted in peanuts. "This is at the rate of 840 pounds of growth from 1 acre of peanuts (with less than half a stand) and 1,710 pounds (35.6 bushels) of corn meal. With pork at 3 cents per pound and corn meal at 40 cents per bushel of 48 pounds, this is a gross return of $25.20 and a net return (after subtracting the value of the meal) of $10.94 per acre of peanuts."

The pigs on peanuts only "pastured an area of 3,517 square feet, and the gain made was 21.1 pounds, which is at the rate of 261 pounds of pork per acre. At 3 cents per pound gross for pork, this gives a value of $7.83 to the acre of peanuts on which there was only half a stand of plants."

Duggar estimates the value of peanuts in pork production at $12 to $20 per acre, the higher returns being made where corn meal supplements the peanut pasture.

Peanuts and chufas compared with grain.—Duggar[b] fed four lots of 3 pigs each for eighteen days to compare the values of peanut and chufa pasture with grain alone. Lot I grazed Spanish peanuts and had a half ration of a mixture, by weight, of corn meal 2 parts and cowpea meal 1 part; Lot II grazed Spanish peanuts without grain; Lot III grazed chufas, with the same half grain ration as Lot I; Lot IV was fed in a bare lot and given all the mixture fed Lot I that the pigs would eat up clean. The following table shows the results:

Peanut and chufa pasture compared with grain.

Area grazed and ration.	Average weight at beginning.	Number of pigs.	Number of days fed.	Total gain.	Average daily gain.
	Pounds.			*Pounds.*	*Pounds.*
Spanish peanuts grazed, one-half grain ration	121	3	18	81	1.50
Spanish peanuts grazed	85	3	18	22	.41
Chufas grazed, one-half grain ration	106	3	18	79	1.46
Full grain ration	131	3	18	71	1.31

[a] Bul. No. 93, Alabama Expt. Sta.
[b] Bul. No. 122, Alabama Expt. Sta.

Peanut and chufa pasture compared with grain.—Continued.

Area grazed and ration.	Total feed eaten.		Grain per 100 pounds gain.	Pasturage on 1 acre for a 100-pound shoat.
	Area grazed.	Grain eaten.		
	Sq. feet.	*Pounds.*	*Pounds.*	*Days.*
Spanish peanuts grazed, one-half grain ration	8,344	152	188	850
Spanish peanuts grazed	12,448	.....	.....	463
Chufas grazed, one-half grain ration	7,937	152	192	827
Full grain ration	.....	304	431	.....

This experiment shows the best returns when grain was fed with these crops. Grazing peanuts alone was very unsatisfactory. The return per acre of peanuts and chufas, with pork at 4 cents per pound, was estimated, where grain was fed, at $9.56 and $9.62, respectively. The pigs on peanut pasture alone returned only $3.03 per acre for the crop. Those on pasture with grain made much more rapid and economical gains than those on grain only.

The last column of the table is especially interesting. With a small amount of grain it is evident that pasture will be available for a much longer period than when no grain is fed.

Grazing sorghum and cowpeas.—Duggar[a] fed four lots of 3 pigs each for five weeks to compare the value of sorghum and cowpea pasture with a grain ration. Lot I was hurdled on drilled sorghum which was in the dough and ripening stages and received a half grain ration of a mixture, by weight, of corn meal 2 parts and cowpea meal 1 part. Lot II was placed in a pen in which sorghum was growing and had, in addition, enough ripe Spanish peanuts to constitute a half ration of peanuts. Lot III was hurdled on drilled Whip-poor-will cowpeas on which part of the pods were ripe and received no grain. Lot IV was confined in a bare pen and given the grain mixture given Lot I in such amount as the pigs would eat up clean. The following table shows the results:

Grazing pigs on sorghum and cowpeas.

Ration.	Number of pigs.	Average weight at beginning.	Total gain.	Number of days fed.	Average daily gain.	Total feed eaten.		Grain per 100 pounds gain.
						Area grazed.	Grain eaten.	
		Pounds.	*Pounds.*		*Pounds.*	*Sq. feet.*	*Pounds.*	*Pounds.*
Grain Grazed sorghum	3	59	75	35	0.71	4,872	244	328
Spanish peanuts Grazed sorghum	3	59	54	35	.51	4,872	.....	.....
Grazed ripe cowpeas	3	57	51	35	.48	17,964	.....	.....
Grain	3	64	124	35	1.18	.....	464	374

[a] Bul. No. 122, Alabama Expt. Sta.

These results are not very satisfactory for grazing on sorghum or on cowpeas without a supplementary grain ration. The waste of feed in the cowpea lot was very great, large numbers of the ripe pease falling to the ground and sprouting. Previous work at the Alabama Station has shown more satisfactory results when grain was fed in conjunction with the cowpea pasture.

Duggar[a] notes another experiment with sorghum grazing, in which there was a large waste of feed, although grain was fed. Seven shoats were on the sorghum from June 24 to September 2, 1899, and received at the same time about 1½ pounds per head daily of a mixture of equal parts, by weight, of cowpea meal and corn meal. The pigs grazed 15,374 square feet of sorghum and 8,380 square feet of second-growth sorghum. They ate 812 pounds of grain, or 360 pounds of grain per 100 pounds of gain. Making allowances for the value of the grain fed, the return per acre of sorghum, with pork at 4 cents per pound, was estimated at $7.80. The second-growth sorghum produced only about one-half as much feed as the first growth. Large quantities of the sorghum were trampled under foot, and when some of it was cut and carried to the pigs a given area lasted much longer than when they were turned in to graze. Duggar suggests that when labor is cheap and abundant or a corn harvester is available soiling sorghum will be the more profitable method of feeding.

Cowpea pasture with corn.—Duggar[b] fed 6 Essex shoats from the same litter to investigate the pasture value of cowpeas. Lot I received corn only. Lot II was hurdled on cowpeas that were about half matured at the beginning of the experiment. The field tested 13.2 bushels per acre of peas, on an unpastured portion. Both lots received hard-wood ashes and salt. The results were as follows:

Cowpea pasture and corn compared with corn alone.

Kind of feed.	Number of pigs.	Average weight at beginning.	Total gain.	Number of days fed.	Average daily gain.	Corn eaten.	Corn per 100 pounds gain.
		Pounds.	*Pounds.*		*Pound.*	*Pounds.*	*Pounds.*
Corn alone	3	50.9	45.2	42	0.36	263.8	586
Cowpea pasture and corn	3	49.4	122.0	42	.97	374.0	307

The pigs were pastured on an area of 7,280 square feet, or about one-sixth of an acre. Valuing pork at 3 cents per pound and corn at 40 cents per bushel, the return for cowpeas per acre is $10.65, not including the value of the manure made. By pasturing, 277 pounds of corn were saved per 100 pounds gain, and therefore an acre of cowpeas would replace 1,662 pounds of corn, using this test as a basis.

The Maryland Station[c] fed a number of pigs on cowpea pasture and concluded that cowpeas are well adapted to pigs about three

[a] Bul. No. 122, Alabama Expt. Sta. [b] Bul. No. 93, Alabama Expt. Sta. [c] Bul. No. 63.

months old. The older pigs that had been highly fed and had always been kept in a pen evidently had lost their rustling ability and did not thrive so well on cowpeas.

PUMPKINS AND APPLES.

Feeding pumpkins raw and cooked.—At Ottawa, Grisdale[a] fed pumpkins to pigs in considerable numbers. A field was specially prepared, the seed being planted in hills 8 feet apart each way. The yield was about 9 tons per acre and the cost 90 cents per ton. In feeding one lot received raw pumpkins and grain (a meal mixture of one-half corn meal and one-half a mixture of equal parts of oats, peas, and barley). The other lot received cooked pumpkins and the same meal mixture.

At the Oregon Station, French[b] took 6 Berkshires, eight months old, from a stubble field where they had been for six weeks and placed them on a ration of pumpkins and shorts. The pumpkins were the common yellow field variety, and were prepared by cutting up, removing the seed, and cooking or steaming, after which shorts were mixed with them.

At the New Hampshire Station, Burkett[c] fed pigs to compare cooked and raw pumpkins. Lot I, consisting of 3 pigs, received skim milk, corn meal, and cooked pumpkins; Lot II, consisting of 3 pigs, received milk, corn meal, and raw pumpkins. The following table shows the result of these experiments:

Value of pumpkins as feed for pigs.

Ration.	Number of pigs.	Average weight at beginning.	Total gain.	Number of days fed.	Average daily gain.	Feed eaten.			Feed per 100 pounds gain.			Cost per 100 lbs. gain.
						Grain.	Milk.	Pumpkins.	Grain.	Milk.	Pumpkins.	
Ottawa:		*Lbs.*	*Lbs.*		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Dolls.*
Raw pumpkins	....	.....	745	107	.....	1,981	.....	2,090	267	.....	281	3.08
Cooked pumpkins	....	.....	706	99	.....	1,602	.....	7,500	227	.....	1,062	2.96
Oregon:												
Cooked pumpkins	6	171.5	499	.....	1.49	924	.....	7,523	185	.....	1,508	2.99
New Hampshire:												
Raw pumpkins	3	142	170	25	2.26	514	630	1,348	302	370	793	3.31
Cooked pumpkins	3	138.6	166	25	2.21	514	630	742	309	379	447	3.32

Averaging these results, the raw pumpkins rations show 273 pounds of grain and 376 pounds of pumpkins for each 100 pounds of gain, and the cooked pumpkins rations, 222 pounds of grain and 1,150 pounds of pumpkins for each 100 pounds of gain.

[a] An. Rpt., 1900, Central Experimental Farm. [b] Bul. No. 54. [c] Bul. No. 66.

Raw pumpkins alone.—Burkett[a] fed one lot of hogs on a ration of uncooked pumpkins with no other feed but skim milk with the following results:

Pigs ..... number..	3	Pumpkins ..... pounds..	3,798
Average weight at beginning ..... pounds..	141	Milk per 100 pounds gain .do....	750
Total gain ..... do....	84	Pumpkins per 100 pounds gain ..... pounds..	4,520
Days fed ..... number..	25	Cost of feed per 100 pounds gain ..... dollars..	2.39
Average daily gain ..... pounds..	1.12		
Milk consumed ..... do....	630		

Feeding pumpkins and apples.—At the same time with the test outlined in the preceding paragraph, Burkett fed a lot of 3 pigs on a ration of apples and pumpkins, half and half, cooked. The pumpkins in all the New Hampshire experiments were raised at a cost of 40 cents per ton; the apples were common cider apples, or windfalls, and were valued at 10 cents per bushel.[b] The results are as follows:

Pigs ..... number..	3	Pumpkins and apples .. pounds..	3,762
Average weight at beginning, pounds	140	Milk per 100 pounds gain .do....	545
Total gain ..... pounds..	116	Pumpkins and apples 100 pounds gain ..... pounds..	3,246
Days fed ..... number..	25	Cost of feed 100 pounds gain, dollars	4.65
Average daily gain ..... pounds..	1.54		
Milk consumed ..... do....	630		

The higher cost of gain in this test is attributed to the apples, and it is questioned whether it pays to feed them at a cost equal to or exceeding 10 cents per bushel.

ROOTS AND TUBERS.

Feeding roots to live stock is comparatively recent in the United States. Corn, with hay and ensilage, has been the principal maintenance during the winter months when pasture was not available. In hog feeding it is safe to say that, until very recent years, almost the only substitutes for pasture were pumpkins, artichokes, and clover or alfalfa hay in certain sections. In England and Canada, however, much dependence is placed on roots, and, while we may never reach the point in this country generally of fattening animals almost entirely on a root diet, the peculiar advantages to be gained by them, their great palatability, and the good effect on the health and thrift of the animal commend roots to the stockman.

A number of experiments have been reported recently on feeding roots to hogs.

At the Indiana Station, Plumb and Van Norman[c] conducted two experiments to compare a ration composed solely of grain with one

[a] Bul. No. 66, New Hampshire Expt. Sta.

[b] New Hampshire has no legal weight per bushel for apples, and this bulletin did not state the weight used. The legal weight in other States varies from 44 to 50 pounds.

[c] Buls. Nos. 79 and 82.

where roots were added. In both experiments the grain ration was 1 part corn meal, 2 parts shorts, fed as slop. No drink other than water was given. In the first experiment mangels were fed; in the second the roots were sugar beets sliced and fed in the slop, and they were relished more than the mangels.

At the Ontario Agricultural College, Day[a] fed four lots of pigs in pens as follows:

Lots I and II were made up of 4 grade Yorkshire pigs each from the same litter, about seven weeks old; Lots III and IV contained 5 grade Yorkshire pigs each from the same litter, about 9 weeks old. Lot I received barley and middlings; Lot II received barley and middlings with an equal weight of raw pulped mangels; Lot III received corn and middlings; Lot IV received corn and middlings with an equal weight of raw pulped mangels. The proportion of grain to middlings was 1:2 in all lots at the beginning of the experiment, and was gradually changed as the pigs increased in weight and age until it was 2:1 toward the close.

At the Utah Station, Foster and Merrill[b] conducted two experiments to compare a ration of bran and sugar beets with rations of corn meal, ground wheat, and corn meal and peas. In the first experiment Lot I received corn meal, Lot II received ground wheat, and Lot III received sugar beets with a one-third ration of bran. In the second experiment Lot I received a mixture of equal parts of corn meal and ground peas, Lots II and III being fed as in the first test. The pigs were fed in covered pens, and were given all they would eat. There were 3 in each lot.

At the Montana Station, Shaw[c] fed one lot of hogs on grain only and another on the same grain ration with sugar beets added. The following table shows the results of these experiments:

Value of roots as feed for pigs.

Ration.	Number of pigs.	Average weight at beginning.	Total gain.	Number of days fed.	Average daily gain.	Total feed eaten.		Feed per 100 pounds gain.		
						Grain.	Roots.	Grain-fed lots.	Grain-and-root fed lots.	
									Grain.	Roots.
Indiana:		*Lbs.*	*Lbs.*		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
Grain	6	46	443	77	0.96	1,643	.....	371	.....	.....
Grain and roots	6	44	356	77	.77	1,320	514	.....	371	145
Grain	4	60	444	98	1.13	1,697	.....	382	.....	.....
Grain and roots	4	60	382	98	.77	1,186	1,568	.....	310	410
Ontario Agricultural College:[d]										
Grain	4	42	501	196	.64	.....	.....	439	.....	.....
Grain and roots	4	42	672	196	.86	.....	.....	.....	380	.....
Grain	5	55	664	196	.68	.....	.....	455	.....	.....
Grain and roots	5	55	744	196	.76	.....	.....	.....	404	.....

[a] An. Rpt., 1901.
[b] Bul. No. 70.
[c] Bul. No. 27.
[d] The grain per 100 pounds gain in the Ontario results is dry matter.

Value of roots as feed for pigs—Continued.

Ration.	Number of pigs.	Average weight at beginning.	Total gain.	Number of days fed.	Average daily gain.	Total feed eaten.		Feed per 100 pounds gain.		
						Grain.	Roots.	Grain-fed lots.	Grain-and-root fed lots.	
									Grain.	Roots.
Utah:		*Lbs.*	*Lbs.*		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
Corn meal	3	97	229	91	.85	1,279	.....	558	.....	.....
Ground wheat	3	97	324	91	1.2	1,505	.....	464	.....	.....
Bran and roots	3	97	167	91	.62	471	2,761	.....	282	1,653
Corn meal and pease	3	87	410	122	1.12	1,672	.....	407	.....	.....
Ground wheat	3	86	330	122	.90	1,330	.....	403	.....	.....
Bran and roots	3	89	258	122	.70	880	[a] 1,771	.....	341	686
Montana:										
Grain	7	111	557	66	1.20	2,967	.....	532	.....	.....
Grain and roots	7	115	576	66	1.26	2,497	819	.....	426	142
Average	.....	.....	.....	.....	.....	.....	.....	442	359	427

[a] Includes 111 pounds of potatoes.

In the experiments tabulated here roots were fed in seven tests to 32 pigs, and in comparison grain was fed in nine tests to 38 pigs, making a total of sixteen lots and 70 pigs. In six of the seven tests where roots were fed there was a saving of grain. In one instance (in Indiana) nothing was gained by feeding roots. The average of feed per 100 pounds gain shows that feeding 427 pounds of roots saved 83 pounds of grain, or 19 per cent, which is a very high value for roots.

This feature of root feeding has previously been remarked upon in this bulletin. Attention is called to it in nearly every instance where experimenters have fed roots successfully. Plumb and Van Norman [a] do not regard their results as showing great value for roots, but think that they have an effect on the appetite, digestion, and general health that is beneficial, particularly in winter. In the Ontario [b] experiments the equivalent for 100 pounds of meal was 319 pounds of roots in the first and 564 pounds in the second. Day calls attention to the fact that both figures are very high values for roots, and points out that, "according to analyses and digestion experiments, there is approximately about nine times as much digestible matter in a mixture of corn and middlings as there is in mangels. It is difficult to explain, therefore, how 564 pounds of mangels should prove equal to 100 pounds of meal." The pigs receiving mangels showed the effects of their feed in more growth and thrift than the others. They had less tendency to become fat, and the root ration was reduced for this reason. Day [b] explains this effect of root feeding to be due to a "beneficial effect on the digestive organs of the animals, causing them to digest their food better than did the others; for there is little doubt that hogs closely confined in pens are likely to suffer from indigestion." Shaw [c] explains the marked effect of roots in similar

[a] Bul. No. 79, Indiana Expt. Sta.
[b] An. Rpt., 1901, Ontario Agricultural College.
[c] Bul. No. 27, Montana Expt. Sta.

words, stating that the value for sugar beets for pigs is "derived not so much from the nutrients in the dry matter which they contain as from the influence they exert on digestion and assimilation." This action of roots in the ration is undoubtedly similar to what has already been noted in the case of dairy by-products and pasture. The improvement that roots bring about in the condition of the digestive system must also affect indirectly the entire system and thus promote the general health.

Henry found the results at three American stations to be that about 615 pounds of roots saved 100 pounds of grain. The Danish experiments give 600 to 800 pounds of mangels and from 400 to 800 pounds of fodder beets as the feeding equivalent of 100 pounds of grain.[a]

The average of the results here given indicates that about 515 pounds of roots saved 100 pounds of meal, a somewhat higher value for roots than that given in previously published work.

An experiment conducted by Shaw[b] at the Montana Station, the results of which were published since the foregoing figures were compiled, showed an average daily gain for pigs of 1.58 pounds, at a cost of $4.60 per 100 pounds gain on grain only (9.11 pounds of grain per head daily); a second lot, on grain and sugar beets (6.65 pounds grain and 4.58 pounds sugar beets per head daily) made an average daily gain of 1.64 pounds, at a cost of $3.80 per 100 pounds. There were 4 pigs in each lot and they were fed 50 days. As a sidelight on the possibilities of pork production in the irrigated Northwest, it is interesting to note that Shaw found his net profit from feeding these 8 pigs to be $14.12, "or 33 per cent on the investment in fifty days."

Comparing various roots.—At the Central Experimental Farm in Canada, Grisdale[c] fed four lots of pigs to compare the feeding value of turnips, mangels, and sugar beets. In each case the meal mixture fed consisted of one-half corn, the other half being equal parts of oats, pease, and barley. In addition each pig was given 3 pounds of milk daily and all the roots he would consume. The roots were fed as follows: Lot I, turnips fed pulped; Lot II, mangels fed pulped; Lot III, sugar beets grown for forage, fed pulped; Lot IV, sugar beets grown for sugar production, fed pulped. The results were as follows:

Value of various roots for pigs.

Ration.	Number of pigs.	Average weight January 7.	Total gain.	Number of days fed.	Average daily gain.	Feed eaten.			Feed per 100 pounds gain.		
						Meal.	Roots.	Milk.	Meal.	Roots.	Milk.
		Lbs.	*Lbs.*		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
Lot I, turnips	4	101.25	363	106	0.85	780	3,808	1,284	215	1,049	354
Lot II, mangels	4	96.75	389	106	.90	786	5,930	1,284	202	1,524	330
Lot III, forage beets	4	76.75	500	106	1.18	793	4,298	1,284	159	860	257
Lot IV, sugar beets	4	57.00	[d]528	138	.95	1,032	4,266	1,680	195	808	318

[a] Feeds and Feeding, pp. 570, 571.
[b] Bul. No. 37.
[c] An. Rpt., 1901.
[d] Feeding ceased May 25.

On Lots I and II no deleterious results are mentioned in either buyers' or packers' reports. On Lot III the buyer reported 3 "select" and 1 "fat," and the packers' report was not so favorable to this lot as to Lots I and II. On Lot IV the buyer reported all "select;" there was no packer's report on carcasses of this lot.

In this experiment the pigs on forage beets made the greatest average daily gains and required the least feed for 100 pounds gain, the other lots standing in the order of sugar beets, mangels, and turnips. The results are remarkably low in feed requirements and would seem to show that roots and milk may be more advantageously combined than pasture and milk.

Day at Guelph and Shutt at Ottawa have found that the effect of roots on the carcass is not detrimental, but produces a firm bacon of good quality—a very essential matter to Canadian pig feeders. In this experiment neither buyers nor packers criticised adversely the pigs fed on turnips and mangels, and the carcasses of the sugar-beet pigs were all "select" (there was no packer's report on this lot); but the buyer found one carcass too fat in the lot fed on forage beets, and the packer's report was not so favorable as on the others.

Sugar beets alone.—At the Colorado Station, Buffum and Griffith[a] fed 4 pigs on sugar beets alone. There was some difficulty at first in inducing the pigs to eat beets, but after they had become accustomed to such a diet they took to it readily. At no time were the pigs able to eat beets enough to approach the conventional feeding standards; 12.50 pounds daily was the greatest amount they would take. For a brief period at the close (two weeks) forage beets were fed, the supply of sugar beets giving out. The results were as follows:

Average weight at beginning	pounds	100
Total gain	do	67
Days fed		99
Average daily gain	pound	.17
Average amount of feed eaten	do	1,027
Feed per 100 pounds gain	do	6,130
Cost per 100 pounds gain	dollars	12.30
Average profit with pork at 7 cents per pound	cent	.13
Dressed weight	per cent	77

Sugar beets alone are thus seen to be only a very expensive maintenance ration.

A comparison of sugar-beet pulp and sugar beets.—In Colorado, Buffum and Griffith[a] fed one lot of pigs on a ration of sugar-beet pulp and equal parts of wheat and barley; another on the same ration, except that sugar beets were fed instead of pulp; the results with a third lot, on equal parts of wheat and barley, are compiled in the table below as a check.

[a] Bul. No. 74.

The pulp cost, laid down at the college, $1 per ton. It was piled on well-drained ground and kept well without an undue amount of fermentation. The beets fed were grown on the college farm. Their cost was estimated at $4 per ton. During the last two weeks of the experiment the supply ran out and forage beets were substituted for sugar beets. The change is not thought to have influenced results.

There was some difficulty in inducing the pigs to eat the pulp, but the sugar beets were eaten from the start, although they were apparently not relished at first. The following table shows the results:

Sugar-beet pulp compared with sugar beets.

Ration.	Number of pigs.	Average weight at beginning.	Average gain.	Number of days fed.	Average daily gain.	Average amount feed eaten.			Feed per 100 pounds gain.			Cost per 100 pounds gain.	Average profit at 7 cents per pound.
						Grain.	Pulp.	Beets.	Grain.	Pulp.	Beets.		
		Lbs.	*Lbs.*		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Dolls.*	*Dolls.*
Grain	4	95	120	104	1.16	546.50	.....	.....	450	.....	.....	4.50	3.90
Beet pulp and grain	4	97	88	99	.89	343	706	.....	390	800	.....	4.30	3.35
Sugar beets and grain	4	101	98	104	.94	416	.....	391	420	.....	400	5.00	2.93

Potatoes.—Clinton[a] reports an unsuccessful attempt at Cornell to feed potatoes raw and cooked. Some grain and skim milk were given in addition, but, while over 400 pounds of potatoes were eaten, the pigs made no progress and were getting out of condition when the experiment was brought to a close. The low temperature while the pigs were being fed, ranging between 29° and 30° F., is suggested as a reason for the poor results.

At the Central Experimental Farm[b] very satisfactory results were obtained from cooked potatoes, but raw potatoes produced little gain. In one experiment the pigs were given all the raw potatoes they would eat, but made no gain and the tubers were discontinued. In a second test a similar experience led to a change to cooked potatoes. The opinion of investigators at this station is that raw potatoes are of little value for feeding pigs, but when cooked they are worth about one-fourth as much as mixed grain.

The following table shows the results of three tests where cooked potatoes were fed with success. The meal fed was a mixture of equal

[a] Bul. No. 199, Cornell University Expt. Sta.
[b] Bul. No. 33.

parts by weight of ground barley, ground rye, ground frozen wheat, and bran:

Cooked potatoes for pigs.

Ration.	Number of pigs.	Average weight at beginning.	Average weight at close.	Average net gain.	Number of days fed.	Average daily gain.	Average amount feed eaten.			Feed per 100 pounds gain.		
							Meal.	Potatoes.	Milk.	Meal.	Potatoes.	Milk.
		Lbs.	*Lbs.*	*Lbs.*		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
Potatoes (cooked), meal (soaked), skim milk	3	56	171	115	140	0.82	177	831	315	152	718	272
Potatoes (cooked), meal, skim milk	3	55	195	140	140	1.00	289	712	105	205	506	74
Potatoes (cooked), meal, skim milk	3	50	192	142	140	1.01	140	1,034	420	98	729	296

Sweet potatoes.—The Alabama, South Carolina, Maryland, and Florida stations have experimented with sweet potatoes with somewhat varying results.

At the Alabama Station, Duggar[a] fed one lot of pigs on a ration of three-fourths sweet potatoes and one-fourth ground cowpeas and another on a ration of equal parts of corn meal and cowpeas. After four weeks they were put through an intermediate period of one week and the rations were reversed, the lot that had formerly been on corn meal and cowpeas receiving the sweet potato ration. This was continued for four weeks longer, so that in all there were eight weeks' feeding on a sweet potato ration.

The ration of sweet potatoes and cowpeas proved very inferior to the ration of corn meal and cowpeas; the increase in live weight was nearly twice as great in the case of corn meal and cowpeas, and the dry matter per 100 pounds of gain was estimated at 600 pounds where sweet potatoes were fed to 360 pounds where corn meal was fed. Duggar refers to the difficulty of inducing the pigs to eat enough dry matter when sweet potatoes made up so much of the ration, and suggests a ration of equal parts of cowpeas and sweet potatoes as being more palatable and nutritious. He questions whether sweet potatoes can be profitably grown, stored, and fed to hogs unless the feeding value per bushel would be more than 10 or 15 cents. Where the pigs do the harvesting, especially on sandy soils, where the yield of sweet potatoes is ten or fifteen times that of corn, they may be an economical feed.

The results at the South Carolina Station were much more favorable to sweet potatoes. Newman and Pickett[b] fed a lot of 3 pigs, averaging 162 pounds in weight, on sweet potatoes only for forty-three days, beginning November 23. At the same time corn was fed to 3 pigs, averaging 156 pounds in weight. Two pigs in each lot were high-grade Berkshires and the third was a grade Duroc Jersey.

[a] Bul. No. 93. [b] Bul. No. 52.

Th pigs on sweet potatoes ate 26.2 pounds per head daily and made an average daily gain of 0.86 pound. They ate 3,247 pounds of sweet potatoes for 100 pounds of gain.

The pigs on corn ate an average of 9.2 pounds of grain daily, and made an average daily gain of 1.39 pounds, requiring 602 pounds of corn for 100 pounds of gain.

It was estimated that, at 200 bushels per acre, sweet potatoes would produce 369.5 pounds of pork per acre, worth $18.47 when pork is worth 5 cents per pound. The gain from corn was 139.5 pounds of pork, and the corn yield was 15 bushels per acre on land similar to that on which the sweet potatoes were grown. At 5 cents per pound for pork, the money return for the corn was $6.97 per acre.

The Maryland Station[a] reports an attempt to maintain pigs exclusively on sweet potatoes. A lot of rather mature pigs was put on a ration of small sweet potatoes and "strings" that were fed raw twice a day for thirty-one days. It required over 5 tons of these potatoes for 100 pounds of gain, and the return from them was only about $1.60 per ton.

The value of this feed when given with grain was tested with a younger lot of pigs for thirty days. With this lot, 593 pounds of sweet potatoes, 277 pounds of milk, and about 60 pounds of grain were required for 100 pounds of gain, and the value per ton of the potatoes was estimated at $2.40, showing sweet potatoes to be more valuable when fed with grain and milk.

The Florida Station[b] fed a lot of 4 native hogs on a ration of equal parts by weight of sweet potatoes and wheat middlings, the ration being 3.5 pounds of each per 100 pounds live weight of hog. They were confined in an open pen and fed twice daily. The hogs averaged 101.5 pounds at the beginning of the test and increased in weight 31.16 per cent, or 126.5 pounds, at a cost of 5.6 cents per pound of gain for feed eaten.

At the Alabama Station, Duggar[c] penned 2 shoats, averaging 116 pounds, on sweet potatoes for thirty-five days. They were given, in addition, 2 pounds of ground corn and 1 pound of ground cowpeas per head daily. In the time specified they gained 67 pounds, an average daily gain of 0.93 pound, thus requiring 313 pounds of grain in addition to the sweet potatoes for each 100 pounds gain. Duggar states that the sweet potatoes were not relished greatly and that there was much waste of them, due probably to the relatively large amount of grain fed.

Artichokes.—At the Oregon Station[d] French took 6 Berkshire pigs from wheat stubble on October 22 and placed them on a field of artichokes that had been planted in April on deep-plowed ground, prepared, as for potatoes, in rows 3 feet apart, with the seed 18 inches apart in the row. The growth was vigorous and the yield abundant, the tops growing to a height of 7 feet during the season,

[a] Bul. No. 63. [b] *Bul. No. 55.* [c] Bul. No. 122. [d] Bul. No. 54.

and a trial plot showing a yield of 740 bushels per acre. The pigs had free access to the field and did all the harvesting. An attempt to sustain them entirely on the tubers failing, some shorts were fed in addition.

At Ottawa, Grisdale[a] sowed a plot of one-sixteenth acre with about 70 pounds of tubers on May 19, planting in rows 24 inches apart, 4 inches deep, and 20 inches apart in the rows. Six pigs were turned in October 3. Although the tubers were immature at that time, the tops were from 10 to 13 feet high. The pigs were allowed a daily grain ration of 1.5 pounds of a mixture composed of one-half corn meal and one-half of a mixture of equal parts of ground oats, pease, and barley.

In both experiments the Jerusalem artichoke (*Helianthus tuberosus*) was used. The following table shows the results:

Artichokes as feed for pigs.

Station.	Number of pigs.	Average weight at beginning.	Total gain.	Number of days fed.	Average daily gain.	Grain fed.	Grain per 100 pounds gain.	Cost of grain per 100 pounds gain.
		Pounds.	*Pounds.*		*Pounds.*	*Pounds.*	*Pounds.*	*Dollars.*
Oregon	6	162.6	244	50	0.81	756	309	1.85
Ottawa	6	104.6	197	21	1.57	189	96	1.80
Average							202.5	1.825

The cost of the meal in the Oregon experiment was estimated at $12 per ton; that in the Canadian one at $18 per ton. Valuing the meat made at $6.25 per 100 pounds, Grisdale estimates that, after deducting the cost of the meal fed, a balance of $10.61 is left for the artichokes fed, and deducting from this the cost of seed, planting, rent of land, etc., the one-sixteenth acre used gave a net return of pork worth $8.76.

ROUGHAGE.

Hogs are generally regarded as animals whose peculiar function is the conversion of concentrated feed into meat. Although the capacity for bulky feed that we find in the stomachs of cattle and sheep is lacking in hogs, a reasonable amount of bulk in the form of roots or hay is palatable and profitable. In many parts of the country, where concentrates are costly feeds, stockmen are forced to use substitutes for at least a part of the grain ration, both for fattening and maintenance, and over the entire country the winter ration is a problem. To solve these problems many western farmers have resorted to the use of alfalfa hay, and outside alfalfa districts clover hay is used. Considerable study has been devoted to this subject by the experiment stations.

Alfalfa hay.—The Kansas Experiment Station[b] has reported a series of experiments with drouth-resistant crops. Three of these

[a] An. Rpt. 1900, Central Experimental Farm. [b] Bul. No. 95.

experiments had to do with alfalfa hay. In the first, the hogs used were of mixed breeding—Berkshire and Poland China—representing about the average of Kansas farm hogs. The alfalfa was of good quality.

Two lots were fed—one receiving the hay whole in greater quantity than it would consume, the other having ground hay. In the second test the meal-fed lot received some cotton-seed meal—0.16 pound to each pound of Kafir corn, which did not affect the hogs seriously. This test was conducted during the most severe weather of the winter, the thermometer registering 32° F. below zero February 12, ten days after the experiment began.

In the third test the grain was wet with water at the time of feeding. The alfalfa hay had been cut late and was rather woody.

The Utah Station [a] fed one lot of hogs on a mixture of equal parts by weight of chopped wheat and bran, wet. Another lot had the same grain ration with chopped alfalfa hay added. "The alfalfa used was well cured and was prepared by running through an ensilage cutter, the blades of which are arranged for cutting into half-inch lengths." The pigs were thrifty grade Berkshires.

The Montana Station [b] fed three lots of hogs to compare the feeding values of a grain ration with sugar beets and alfalfa hay as roughage with a ration of grain only. The results of the lots that were fed on grain alone and on grain and alfalfa hay are presented herewith. The lot on grain alone received a ration consisting, during the early part of the experiment, of 2 parts of damaged wheat and 1 part oats, barley taking the place of the wheat during the latter part of the experiment. The hay-fed lot had the same ration with alfalfa hay added. The alfalfa hay was run through a cutting box, moistened, and mixed with meal. The hogs were by a Berkshire boar out of high-grade Poland China sows. They had previously had the run of a stubble field, with some clover pasture.

The following table shows the results of these experiments:

Value of roughage for pigs.

Ration.	No. of pigs.	Average weight at beginning.	Total gain.	No. of days fed.	Average daily gain.	Feed eaten.		Feed per 100 pounds gain.	
						Grain.	Hay.	Grain.	Hay.
Kansas:		*Lbs.*	*Lbs.*		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
Kafir corn meal, dry	10	126	524	63	0.83	3,925	.....	749	.....
Kafir corn meal, dry, and whole alfalfa hay	10	127	909	63	1.44	4,679	659	515	72.4
Kafir corn meal, dry, and ground alfalfa hay	10	127	833	63	1.32	4,479	656	538	78.7
Kafir corn meal, and cotton-seed meal, wet	6	161	126	22	.95	681	.....	540	.....
Kafir corn meal, wet, and whole alfalfa hay	6	164	117	22	.88	629	251	538	214

[a] Bul. No. 70. [b] Bul. No. 27.

Value of roughage for pigs—Continued.

Ration.	No. of pigs.	Average weight at beginning.	Total gain.	No. of days fed.	Average daily gain.	Feed eaten.		Feed per 100 pounds gain.	
						Grain.	Hay.	Grain.	Hay.
Kansas—Continued.		*Lbs.*	*Lbs.*		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
Kafir corn, whole	10	138	456	50	.91	2,910	.....	640	.....
Kafir corn meal	10	139	441	50	.88	2,872	.....	653	.....
Kafir corn, whole, and alfalfa hay	10	142	685	50	1.37	3,434	898	501	131
Kafir corn meal and alfalfa hay	10	140	686	50	1.37	3,535	844	516	123
Utah:									
Chopped wheat and bran	4	58	689	135	1.28	3,196	.....	464	.....
Chopped wheat and bran and chopped alfalfa hay	4	58	647	135	1.19	2,942	270	455	41.7
Montana:									
Grain only	7	111	557	66	1.20	2,967	.....	532	.....
Grain and alfalfa hay	7	111	552	66	1.19	2,683	370	486	67
Average:									
For lots fed grain only	.....	.....	.....	.....	.....	.....	.....	593	.....
For lots fed hay	.....	.....	.....	.....	.....	.....	.....	505	89

The feeding value of alfalfa hay, as indicated in the foregoing tables, does not in the least warrant a claim that it can be used economically as the sole ration. In all but two instances a considerable saving of feed was found to be effected by its use, but the statement that its feeding value is almost equal to that of corn is true only within certain limits. Where hogs are confined to an exclusive grain ration, and especially where this is made up of a single grain, the addition of a moderate amount of hay to the ration will be relished and less grain will be required. At the same time, better and cheaper gains are usually made by hogs so fed than by those on grain alone, but the value of the grain saved is out of all proportion to the value of the hay fed, and the hay in the ration can not be used economically in more than very moderate amounts. This is a similar fact to that which has been found by many investigators with such bulky feeds as green clover, rape, roots, and skim milk. That it is bad economy to attempt the maintenance of hogs on alfalfa hay alone is shown by the experiment noted below by McDowell in Nevada.

A consideration of the approximate proportions of hay to grain fed in these experiments is of interest. The greatest proportion of hay to grain was fed at the Kansas Station and the ratio was 1:2.5. With this ratio the least daily gain was made. The gains were the most expensive of any of the lots, and no advantage accrued from the use of hay. The least proportion of hay (1:11) was fed at Utah and gave the most economical gains. The greatest daily gain and the greatest amount of grain saved was in a Kansas lot fed whole alfalfa hay and

dry Kafir corn meal in the proportion of 1:7. The following table shows the effect of these rations in greater detail. The best results seem to come from the use of hay in the proportion of from one-seventh to one-fourth of the ration when hay makes up all the roughage:

Ratio of hay to grain in feeding hogs.

Ratio of hay to grain.	Average daily gain.	Feed per 100 pounds gain.		Grain saved.
		Grain.	Hay.	
Kansas:	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
1:2.5	0.88	538	214	1.8
1:4	1.37	501	131	130
1:4	1.37	516	123	137
1:7	1.44	515	72.4	234
1:7	1.32	538	78.7	211
Montana:				
1:7	1.19	486	67	46
Utah:				
1:11	1.19	455	41.7	9

Feeding alfalfa hay alone.—There is very little experimental work work on this phase of the subject. The opinions of experimenters and of stockmen generally seem to be that whenever hay alone is resorted to it is no better than a maintenance ration. In the alfalfa-growing districts hogs are frequently run through the winter at the haystacks owing to the scarcity and expense of a grain ration. At the Nevada Station, McDowell[a] fed two lots of 2 pigs each on a ration of alfalfa hay. The two lots ate in twenty-one days 99.12 pounds and 99.14 pounds, respectively, and lost in weight 33.25 pounds and 51 pounds, respectively, an average daily loss of 0.79 pound and 1.21 pounds, respectively. "While feeding hay alone the pigs spent much time curled up in the bedding, but when about the stalls were restless, and even in eating it was done in a ravenous way unlike that of a hearty, well-fed pig." After the hay-feeding period both lots were given grain and roots and made satisfactory gains.

Sugar beets compared with alfalfa hay.—The Utah Station[b] conducted three experiments, which give valuable data on the relative feeding value of sugar beets and alfalfa as winter roughage. In the first experiment Lot I had all the alfalfa hay they would eat and 2 pounds of corn meal per head daily. Lot II received all the beets they would eat and 2 pounds of bran per head daily.

In the second experiment Lot I had all the alfalfa hay they would eat and 2 pounds of bran per head daily; Lot II had all the alfalfa hay they would eat and 3 pounds of bran per head daily; Lot III had all the sugar beets they would eat and 2 pounds of bran per head

[a] Bul. No. 40. [b] Bul. No. 70.

daily; Lot IV had all the sugar beets they would eat and 3 pounds of bran per head daily.

In the third experiment Lot I had all the alfalfa hay they would eat and 2 pounds of a grain mixture of equal parts by weight of bran and chopped frozen wheat per head daily; Lot II was fed all the alfalfa hay they would eat and 3 pounds of the same grain mixture as Lot I per head daily; Lot III had all the sugar beets they would eat and the same grain ration as Lot I; Lot IV was fed all the sugar beets they would eat and the same grain ration as Lot II.

The Montana Station[a] fed one lot of 7 pigs on a grain ration consisting of 2 parts of damaged (frosted) wheat and 1 part oats, with raw sugar beets; another lot of 7 pigs had the same grain mixture, with chopped alfalfa hay. Barley replaced the wheat during the latter part of the experiment.

The following table combines the results of these experiments:

Alfalfa hay compared with sugar beets for pigs.

Ration.	Number of pigs.	Average weight at beginning.	Total gain.	Number of days fed.	Average daily gain.	Feed eaten.			Feed per 100 pounds gain.		
						Grain.	Hay.	Beets.	Grain.	Hay.	Beets.
Utah:		*Lbs.*	*Lbs.*		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
Alfalfa and corn meal	3	102	195	75	0.86	751	372	.....	385	191	.....
Sugar beets and bran	3	96	174	75	.77	[b]719	.....	1,109	414	.....	637
Alfalfa and 2 pounds bran per head daily	3	98	77	54	.47	315	242	.....	407	312	.....
Alfalfa and 3 pounds bran per head daily	3	102	85	54	.52	472	145	.....	553	170	.....
Sugar beets and 2 pounds bran per head daily	3	103	121	54	.75	315	.....	1,870	251	.....	1,541
Sugar beets and 3 pounds bran per head daily	3	102	155	54	.95	473	.....	1,270	305	.....	821
Alfalfa and 2 pounds grain per head daily	5	58	211	71	.59	700	388	.....	332	136	.....
Alfalfa and 3 pounds grain per head daily	5	61	292	71	.82	1,050	219	.....	359	75	.....
Sugar beets and 2 pounds grain per head daily	5	61	282	71	.79	700	.....	3,024	247	.....	1,072
Sugar beets and 3 pounds grain per head daily	4	92	301	71	1.06	1,050	.....	1,843	348	.....	611
Montana:											
Alfalfa and grain	7	111	552	66	1.19	2,683	370	.....	486	67	.....
Sugar beets and grain	7	114	576	66	1.26	2,497	.....	819	426	.....	142
Average, alfalfa	----	----------	------	----	------	----------	------	-------	423	123	.....
Average, sugar beets	----	----------	------	----	------	----------	------	-------	358	.....	617

[a] Bul. No. 27.

[b] Includes 235 pounds of corn meal.

This table shows an average for pigs fed on grain and alfalfa of 423 pounds of grain and 123 pounds of hay per 100 pounds of gain, and an average for pigs fed on grain and sugar beets of 358 pounds of grain and 617 pounds of beets—a difference of 65 pounds of grain, or over 15 per cent in favor of sugar beets.

Alfalfa hay and sugar beets in a grain ration.—Since the foregoing results were compiled the Colorado Station[a] has reported results unfavorable to either hay or sugar-beet feeding. Nine Berkshire pigs, averaging about 150 pounds, were fed. Lot I received a mixture of approximately 2 parts barley and 1 part corn, and about one-half pound alfalfa hay daily; Lot II had the grain ration only; Lot III had the grain ration and about 1 pound of sugar beets daily. There was some difficulty at first to get the pigs in Lot I to eat alfalfa, but when it was cut fine and mixed with barley slop they would take it. The results were as follows:

Alfalfa hay compared with sugar beets for pigs.

Ration.	Number of pigs.	Average weight at beginning.	Average gain.	Number of days fed.	Average daily gain.	Average amount feed eaten.				Feed per 100 pounds gain.			Cost per 100 pounds gain.	Average profit, pork at 5 cents per pound.
						Corn.	Barley.	Hay.	Beets.	Grain.	Hay.	Beets.		
		Lbs.	*Lbs.*		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Dolls.*	*Dolls.*
Grain and alfalfa hay	3	162	101	97	1.13	410	191	55	.....	544	49	.....	4.90	1.73
Grain only	3	155	105	97	1.08	381	174	.....	.....	528	.....	.....	4.60	1.94
Grain and sugar beets	3	148	96	97	.99	350	184	.....	99	555	.....	103	5.20	1.26

In this experiment neither the feeding of beets nor hay gave economical results. Grain feeding was cheaper than either, although the gains from grain and hay were somewhat larger than those from the pigs on grain only. The proportion of hay to grain fed in this experiment was approximately 1:11; that of beets to grain was a little wider than 1:5.

Corn fodder.—The Maryland Station has conducted a number of experiments with ground corn fodder, or "new corn product," as it is otherwise called. This product is the ground residue of cornstalks from which the pith has been removed. It was fed to pigs varying in age at the beginning from eight to twelve weeks. All rations contained milk, and the fodder was fed in different proportions to note any possibly advantageous results from such a practice. No special advantages could be observed from feeding the corn fodder, either in

[a] Bul. No. 74.

lessening the amount of grain required for 100 pounds of gain or in lowering the cost, except after the pigs were six months old. For fairly mature pigs the "new corn product" probably would have an effect in a ration somewhat similar to that of alfalfa hay.

BREED TESTS.

INFLUENCE OF BREED ON FEEDING POWERS.

In the foregoing pages attention has been called to the fact that there is very little difference in the standards of excellence for the various breeds of what has come to be designated the "lard," "fat," "block," or "corn-belt" hog. Tests of the different breeds made in different parts of the country show that, with standards that are similar to a large extent, there is very little difference in the cost of pork production by the best representatives of any of the established breeds. Indeed, these experiments show rather more, for they indicate that the breeds of the bacon type rank well in economy of gain with those of the "corn-belt" lard type. Curtiss and Craig[a] quote Hayward of the Pennsylvania Station to the effect that the results obtained in Maine, Massachusetts, and Ontario show the feed eaten per 100 pounds gain by various breeds to be as follows: Poland China, 407 pounds; Berkshire, 419 pounds; Tamworth, 420 pounds; Chester White, 500 pounds; Duroc Jersey, 522 pounds. The writer has averaged results for six leading breeds obtained by various experiment stations when there were a sufficient number of tests and a total number of pigs large enough to make the averages thoroughly representative. The stations whose figures were used are Maine, Vermont, New York State, Michigan, Wisconsin, and Iowa, in the United States, and the Ontario Agricultural College and the Central Experimental Farm, in Canada. The following table shows a variation in feed per 100 pounds of gain from 344 to 418 pounds:

Feed required for 100 pounds gain by different breeds.

Breed.	Number of tests.	Number of pigs.	Feed per 100 pounds gain.
			Pounds.
Tamworth	16	92	344
Chester White	13	71	367
Poland China	22	96	357
Berkshire	23	121	389
Large Yorkshire	11	67	405
Duroc Jersey	11	66	418

[a] Bul. No. 48, p. 444, Iowa Expt. Sta.

Iowa experiments.—Curtiss and Craig have reported the results of three years' feeding of purebred pigs of six leading breeds, including representatives of the Tamworth and Yorkshire breeds. While the pigs were with the dam, records were kept of all feed consumed and the loss or gain, and the loss or gain in weight of the sows was entered in the accounts of the total pork production before weaning. Henry reports the results of trials with 8 litters of pigs at the Wisconsin Station,[a] when he found the feed required for 100 pounds gain by both sows and pigs before weaning to be little more than that required by the pigs alone after weaning. In the Iowa tests there was a very marked variation in the maintenance of flesh by the sows, which was perhaps due rather more to individual than to breed differences, and which had much to do with the economy of the feeding before weaning. The average cost of 100 pounds of gain for the three years' experiments, both for the sows and pigs before the latter were weaned and for the pigs after weaning, was as follows:

Cost of 100 pounds of gain before and after weaning.[a]

Breed.	Sows and pigs before weaning.	Pigs after weaning.	Breed.	Sows and pigs before weaning.	Pigs after weaning.
Berkshire	$4.29	$2.33	Duroc Jersey	$5.61	$2.27
Poland China	3.15	2.23	Yorkshire	1.83	2.14
Chester White	3.27	2.46	Tamworth	2.22	2.42

[a] Bul. No. 48, Iowa Expt. Sta.

According to these figures, sows of the bacon breeds (Yorkshire and Tamworth) only made cheaper gains with their pigs before weaning than the pigs alone after weaning. The Poland China sows showed the cheapest gains among those of the lard, or fat, type.

After weaning the pigs, the Iowa Station [b] put on feed those that were in thrifty condition and compared the same breeds from this standpoint. The conditions of feed and management were as nearly alike as possible for each breed in each year's feeding. The nutritive ratio was 1:5.8 for all breeds in the first experiment, from 1:5.5 to 1:5.7 in the second, and from 1:7.1 in the third. The first year's work was nearly wrecked by hog cholera, so that the results of only a limited period of time were published. The following table has been arranged from the results, to show the feeding record of each breed in each experiment and the average of each breed for the three years' feeding.

[a] Feeds and Feeding, p. 541. [b] Bul. No. 48, Iowa Expt. Sta.

Breed tests of pigs—three years' experiments. [a]

Breed.	Number of pigs.	Average age at beginning.	Average weight at beginning.	Average weight at close.	Total gain.	Number of days fed.	Average daily gain.	Dry matter consumed.	Dry matter per 100 pounds gain.	Cost per 100 pounds gain.
Berkshire:		*Days.*	*Lbs.*	*Lbs.*	*Lbs.*		*Lbs.*	*Lbs.*	*Lbs.*	*Dolls.*
First experiment	10	59	26	90	631	92	0.68	2,920	462	3.08
Second experiment	10	43	31	192	1,588	153	1.03	6,056	381	2.17
Third experiment	10	65	43	214	1,717	164	1.04	.....	481	2.23
Average	....	.....	.....	.....	.....	....	.98	.....	441	2.49
Poland China:										
First experiment	5	63	40	107	334	92	.72	1,418	424	2.76
Second experiment	8	59	38	201	1,234	153	1.00	4,844	392	2.24
Third experiment	10	54	32	193	1,606	164	.97	.....	441	2.12
Average	....	.....	.....	.....	.....	....	.90	.....	419	2.33
Chester White:										
First experiment	10	59	33	103	689	92	.74	3,196	463	2.95
Second experiment	10	49	30	185	1,551	153	1.01	6,113	394	2.28
Third experiment	9	55	26	179	1,383	164	.93	.....	506	2.41
Average	....	.....	.....	.....	.....	....	.89	.....	454	2.46
Duroc Jersey:										
First experiment	10	58	34	115	828	92	.90	3,206	383	2.45
Second experiment	9	60	39	207	1,517	153	1.10	5,124	337	2.05
Third experiment	10	52	29	187	1,575	164	.95	.....	506	2.38
Average	....	.....	.....	.....	.....	....	.98	.....	410	2.29
Yorkshire:										
First experiment	6	69	35	109	447	92	.80	1,782	398	2.55
Second experiment	9	68	46	225	1,609	153	1.16	5,851	365	2.09
Third experiment	5	61	45	236	957	164	1.16	.....	505	2.04
Average	....	.....	.....	.....	.....	....	1.04	.....	423	2.14
Tamworth:										
First experiment	7	49	33	104	502	92	.77	2,128	403	2.82
Second experiment	10	60	52	210	1,539	153	1.00	6,266	407	2.31
Third experiment	8	75	52	221	1,354	164	1.03	.....	558	2.47
Average	....	.....	.....	.....	.....	....	.93	.....	456	2.62

[a] Bul. No. 48, Iowa Expt. Sta.

These figures show that the Yorkshires averaged highest in average daily gains, with the Berkshires and Duroc Jerseys tied for second place, and the Tamworth pigs next. In feed (digestible dry matter) required for 100 pounds gain, the Duroc Jerseys were first in least requirement, with the Poland Chinas next, the Yorkshires third, and the Tamworths last. In cost of 100 pounds gain the Yorkshires were first, the Poland Chinas second, the Duroc Jerseys third, and the Tamworths fifth. This evidence seems to disprove the charges sometimes made against the bacon breeds, namely, that these pigs make smaller and more expensive gains than those of other breeds.

Ontario experiments.—From the Ontario Agricultural College, Day has reported a number of experiments with six leading breeds. The pigs were fed for comparative purposes. At the close of each feeding period carcasses were examined for their suitability for the export trade, and reports were made thereon by the packers who killed the pigs. The following table shows the results of the feeding tests for five years, with the average of four:

Breed tests of pigs—five years' experiments.[a]

Breed.	Year of test.	Average weight at beginning.	Average weight at close.	Number of days fed.	Average daily gain.	Feed eaten.	Meal per 100 pounds gain.
		Pounds.	*Pounds.*		*Pounds.*	*Pounds.*	*Pounds.*
Berkshire	1896	66	185	117	1.010	475	398.00
	1897	53	145	90	1.020	301	327.17
	1898	50	170	112	1.070	.....	369.79
	1899	.....	.....	.....	.....	.....	[b]318.28
	1900	.....	.....	.....	.803	.....	409.00
Average of 4 tests		.....	.....	.....	.978	.....	378.74
Poland China	1896	69	190	117	1.030	507	417.00
	1897	52	128	90	.840	253	332.89
	1898	69	187	112	1.050	.....	383.22
	1899	.....	.....	.....	.....	.....	[b]349.99
	1900	.....	.....	.....	.701	.....	474.00
Average of 4 tests		.....	.....	.....	.905	.....	401.78
Duroc Jersey	1896	62	199	117	1.160	580	424.00
	1897	65	149	90	.940	302	358.05
	1898	59	179	112	1.070	.....	376.04
	1899	.....	.....	.....	.....	.....	[b]337.10
	1900	.....	.....	.....	.883	.....	426.00
Average of 4 tests		.....	.....	.....	1.014	.....	396.02
Chester White	1896	62	185	117	1.050	557	452.00
	1897	52	127	90	.830	255	340.00
	1898	56	175	112	1.060	.....	377.77
	1899	.....	.....	.....	.....	.....	[b]336.68
	1900	.....	.....	.....	.666	.....	433.00
Average of 4 tests		.....	.....	.....	.902	.....	400.69
Yorkshire	1896	50	177	117	1.080	589	468.00
	1897	60	144	90	.930	285	340.62
	1898	52	176	112	1.100	.....	350.10
	1899	.....	.....	.....	.....	.....	[b]334.85
	1900	.....	.....	.....	.930	.....	422.00
Average of 4 tests		.....	.....	.....	1.010	.....	395.18
Tamworth	1896	54	171	117	1.000	469	400.00
	1897	52	139	90	.970	289	330.92
	1898	48	167	112	1.060	.....	377.77
	1899	.....	.....	.....	.....	.....	[b]331.16
	1900	.....	.....	.....	.642	.....	462.00
Average of 4 tests		.....	.....	.....	.918	.....	390.17

[a] An. Rpts., 1896-1900, Ontario Agricultural College. [b] Dry matter, not included in averages.

These figures show that the Duroc Jersey averaged first in average daily gains with 1.014 pounds, the other breeds following in this order: Yorkshire, Berkshire, Tamworth, Poland China, and Chester White. There is, however, very little difference between the Duroc Jersey, Yorkshire, and Berkshire in respect of average daily gains, and the Tamworth, Poland China, and Chester White form a second group, with average daily gains of slightly more than 0.90 pound. In the economy of gain the Berkshire stands first with 378.74 pounds as the amount of meal required for 100 pounds of gain, the other breeds following in this order: Tamworth, Yorkshire, Duroc Jersey, Chester White, and Poland China. In this respect the Berkshire is quite a little in the lead. The Yorkshire and Duroc Jersey form a group around 395 pounds and the Chester White and Poland China another group at 400 pounds. The Tamworth required 390.17 pounds meal for 100 pounds gain—somewhat less than the Yorkshire and Duroc Jersey.

Minnesota experiments.—At the Minnesota Station, Shaw [a] fed pigs of the Tamworth and Yorkshire breeds in comparison with Poland China. Like the Iowa trials, this was really a comparison of the feeding ability of pigs of the bacon type with those of the lard type.

They were fed in pens 8 by 12 feet, with access to yards, but without pasture. The grain fed consisted of shorts, corn meal, and ground barley in varying proportions, and in the first experiment skim milk was fed. In both experiments green and succulent feed, such as pease, oats, corn, rape, and roots, was fed. During the first experiment one lot of Poland China pigs was on a ration that was mainly of corn meal, some shorts being fed in addition. The pigs in the first experiment were sold at $4 per 100 pounds and those of the second at $4.85 per 100 pounds. The following are the results for the purebred lots:

Breed tests of pigs—two experiments.

Breed.	Number of pigs.	Average weight at beginning.	Average gain.	Number of days fed.	Average daily gain.	Feed eaten.			Cost per 100 pounds gain.	Profit.
						Meal.	Milk.	Green feed.		
First experiment:		*Lbs.*	*Lbs.*		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Dollars.*	*Dollars.*
Poland China	3	44	88	126	0.70	378	84	74	2.52	0.86
Poland China (corn-fed)	3	46	84	126	.67	398	44	143	2.31	.96
Tamworth	3	44	117	126	.93	418	44	144	2.01	1.89
Large Yorkshire	3	35	122	126	.97	419	53	161	2.02	2.07
Second experiment:										
Tamworth	3	51	119	126	.94	415	.....	252	2.32	2.68
Large Yorkshire	3	41	134	126	1.06	427	.....	252	2.11	3.40
Poland China	3	44	121	126	.96	454	.....	224	2.48	2.58

Wisconsin experiments.—The Wisconsin Station [b] tabulated the results of feeding for the different breeds and crosses used in an

[a] Bul. No. 73. [b] Eighteenth An. Rpt., p. 57.

experiment with pease and corn meal. The following table shows the averages:

Results of feeding pigs of various breeds and crosses.

Breeding.	Number of pigs.	Average amount of grain eaten daily.	Average daily gain.	Total gain per pig.	Feed per 100 pounds gain.	Cost per 100 pounds gain.	Internal fat.	Thickness of surface fat.
		Pounds.	*Pound.*	*Pounds.*	*Pounds.*	*Dollars.*	*Pounds.*	*Inches.*
Razorback-Poland China	2	4.27	0.985	166	433	4.967	13.35	2 705
Razorback-Berkshire	2	2.86	.57	119	505	5.772	9.52	2.32
Small Yorkshire	2	3.52	.875	148	400	4.556	9.67	2.21
Razorback	4	2.73	.52	110	547	6.227	10.378	1.99

Particular attention is called to the low gains of the Razorbacks, the large amount of feed they required for 100 pounds gain, and the large amount of internal fat.

In the Wisconsin[a] experiment to compare pease and middlings with corn meal the Berkshires made an average gain in one hundred and twenty-six days of 169 pounds—an average of 1.34 pounds daily for each pig. The Poland Chinas gained 153 pounds each—an average of 1.21 pounds each daily. The Yorkshires, leaving out of consideration a pig that fed poorly, made an average gain in one hundred and twenty-six days of 137 pounds—an average daily gain each of 1.08 pounds. The authors of the Wisconsin report state that this should not be regarded as a breed test.

These experiments, taken in connection with the evidence of investigators over the entire country, undoubtedly show that representative pigs of the different breeds do not differ materially either in the rate of gain or the economy with which the gains are made. Any marked differences in the breeds will be manifested in the suitability of the fattened animals for market and the quality of the carcass on the block. A very notable feature is the showing of the bacon breeds when compared with the lard breeds. The fact that a pig is a Yorkshire or a Tamworth can not be taken as prima facie evidence that it will make slow and expensive gains.

Value of different crosses.—At the Minnesota Station, Shaw[b] fed four lots of pigs to determine the relative value of Yorkshire pigs of first and second crosses. The pigs of the first cross were by a purebred Large Improved Yorkshire boar out of a high-grade Berkshire sow. Those of the second were sired by the same Yorkshire boar, out of a sow whose dam was the grade Berkshire that was the dam of the first litter and whose sire was a purebred Yorkshire. The four lots were therefore as nearly identical in breeding as possible without extreme inbreeding.

Lots I and III were first-cross pigs and Lots II and IV second cross. Lots I and II received a corn-and-oats diet and Lots III and IV a

[a] Seventeenth An. Rpt., p. 16. [b] Bul. No. 60.

barley-and-oats ration; and each lot had an 8 by 12 foot pen in a piggery, with a small paddock adjoining, where they ran for an hour or two daily.

The corn-and-oats ration was 1 part corn to 3 parts oats during the first period; during the second, 2:2; during the third, 3:1; and during the fourth, corn only. In the barley-and-oats rations barley substituted corn in the same proportion. Grain was ground, soaked twelve hours, and a little salt given at each feed. The pigs received all they would eat with relish. Some green feed, such as corn, second-growth clover, rape, and cabbage, was given.

Feeding tests of different crosses.

Breeding.	Number of pigs.	Age at beginning.	Total weight at beginning.	Total weight at close.	Total gain.	Number of days fed.	Average daily gain.	Grain feed eaten.	Green feed eaten.	Grain feed per 100 pounds gain.	Green feed per 100 pounds gain.	Cost per 100 pounds gain.
		Days.	*Lbs.*	*Lbs.*	*Lbs.*		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Dolls.*
Lot I, first cross	3	108	247	601	354	112	1.05	1,394	322	393	111	1.65
Lot II, second cross	3	108	275	603	328	112	.98	1,483	297	452	90	1.89
Lot III, first cross	3	108	247	526	279	112	.83	1,178	267	422	95	1.63
Lot IV, second cross	3	108	279	567	288	112	.86	1,284	297	445	103	1.90

Other comparative results were as follows:

Average daily gain of first-cross	pound	0.94
Average daily gain of second-cross	do	.92
Cost of 100 pounds gain of first cross	dollars	1.74
Cost of 100 pounds gain of second cross	do	1.93

Comparing differing crosses.—Shaw[a] conducted two experiments to compare crosses of different breeds. The pigs were fed in 8 by 12 foot pens, with access to yards and lots adjoining for exercise, but no pasture. They were fed eighteen weeks. The feed was a mixture of shorts, corn, and barley, some green and succulent feed in season, such as peas, oats, rape, corn, and roots was given in each experiment, and all conditions were similar, except that during the first experiment the pigs had skim milk.

The pigs of the first experiment were sold at $4 per 100 pounds; those of the second, at $4.85 per 100 pounds.

The breeding was as follows:

First experiment:

Tamworth–Poland China cross.
Second cross, Large Improved Yorkshire on Berkshire.
Third cross, Large Improved Yorkshire on Berkshire.
Large Improved Yorkshire–Poland China cross.

[a] Bul. No. 73, Minnesota Expt. Sta.

Second experiment:

Third cross, Large Improved Yorkshire on Berkshire.
Large Improved Yorkshire–Poland China cross.
Tamworth–Poland China cross.
Large Improved Yorkshire–Poland China cross (Minnesota-bred dam).
Large Improved Yorkshire–Berkshire cross.

In the first experiment "The Tamworth–Poland China and Large Improved Yorkshire–Poland China crosses were obtained similar to those above described[a] and from a pure Tamworth and pure Large Improved Yorkshire sire, respectively. The second cross, or grade, of Yorkshire on Berkshire was from a dam the progeny of a Large Improved Yorkshire sire and a dam essentially Berkshire, but not registered. The third cross of Yorkshire on Berkshire was of breeding similar in kind, but once removed further from the original Berkshire dam."

In the second experiment there were some slight changes; the pigs of one Yorkshire–Poland China lot were out of a dam reared in the corn belt, while those of the other were out of a Minnesota-bred dam. "In several instances, however, the blood lines were not only the same, but the animals in the experiment were from the same sire and dam, as were those of the previous year." The results follow:

Feeding tests of crossbred pigs.

Breeding.	Number of pigs.	Average weight at beginning.	Average gain.	Number of days fed.	Average daily gain.	Feed eaten.			Cost per 100 pounds gain.	Profit.
						Grain.	Milk.	Green feed.		
First experiment:		*Lbs.*	*Lbs.*		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Dolls.*	*Dolls.*
Tamworth-Poland China	2	47	118	126	0.94	456	83	80	2.24	1.61
Second cross, Yorkshire-Berkshire	3	56	131	126	1.04	499	72	108	2.17	1.84
Third cross, Yorkshire-Berkshire	3	33	104	126	.83	410	47	142	2.28	1.46
Yorkshire-Poland China	3	48	128	126	1.02	483	44	145	2.16	1.87
Second experiment:										
Third cross, Yorkshire-Berkshire	3	45	126	126	1.00	427	.....	252	2.25	2.98
Yorkshire-Poland China	2	63	166	126	1.32	577	.....	252	2.28	3.86
Tamworth-Poland China	3	48	147	126	1.17	482	.....	252	2.16	3.64
Yorkshire-Poland China (Minnesota-bred dam)	3	49	158	126	1.25	527	.....	252	2.18	3.89
Yorkshire-Berkshire	3	46	152	126	1.21	504	.....	196	2.43	3.38

Among Shaw's conclusions are the following remarks:

That the experiments do not sustain the view that the results will be less satisfactory from each succeeding cross of Yorkshire on Berkshire.

That the cross of Large Improved Yorkshire and Tamworth breeds upon the

[a] See experiments with crossbred swine, pp. 183, 184.

Poland China sows of the corn-reared types produces animals at once vigorous, shapely, of better growth, and relatively more profitable than pigs from the aforementioned sows.

INFLUENCE OF BREED ON THE CARCASS.

For the sake of convenience the term "slaughter test" is used in this bulletin to include everything from weighings on the floor of a packing house to a chemical analysis. Sufficient attention has not been paid to the effect of feed and conditions of management on the carcass, but the present drift of sentiment among workers in animal husbandry points to a more thorough study of the carcass in detail as a means of solving the problems that still confront the student and the feeder. No one can doubt that such investigations will have a high value when applied under feed-lot conditions.

At the close of the last two Iowa[a] experiments most of the hogs were shipped to Chicago and sold on the open market. In both experiments the different breeds had been fed on practically the same rations, and all conditions of feeding and management were similar; so that whatever differences might be found in the carcasses could very properly be ascribed to breed influence. In the packing house where the hogs were killed careful records were kept of the slaughtering, and elaborate reports made of these records. The following table has been arranged from these results. It shows the percentage of dressed weight of each breed and the total and average weights of the heads and viscera for each breed:

NOTES ON THE FOLLOWING TABLE.

NOTE.—The writer is under obligations to Swift & Co., Chicago, who killed the hogs, for the following explanation of terms used in these slaughter tests that are not self-explanatory:

Heads, gross.—The gross weight of the heads just as cut from the hogs, with tongues and lean meat in.

Heads, net.—The same heads trimmed for tank—tongues, cheek meat, and cheek-meat fat taken out.

Cheek meat.—Refers to the lean meat in the cheek of the hog. Scientifically expressed, includes masseter (*pterygoideus internus* and *externus*) muscles.

Cheek-meat fat.—The fat trimmed off in saving the lean meat.

Ham facings.—Refers to the facing of fat which is taken off the inside of the hams in order to give them a lean appearance and is taken off in all cases where American cut hams are made. Where English long-cut hams are made this facing of fat is left on, accounting for the fact that in some of the tests ham facings are shown; in other tests they are not.

Plucks.—The liver, heart, and lungs comprise what is called the pluck. Total weight of the livers, hearts, and lungs added together should agree with the total weight of the plucks. Some differences in 1897 test, but weights balance approximately in 1898 test.

Bladders, gross.—The weight of the bladders as taken from the hogs filled, more or less, with urine.

Bladders, net.—Weight of the same bladders with the urine pressed out.

Gut fat.—Large intestines washed out.

Caul fat.—Omentum.

Ruffle fat.—Mesentery.

Bung guts, gross.—Floating colon and rectum combined is called the bung gut, and bung guts, gross, is weight before being cleaned.

Bung guts, net.—Same as above, but cleaned.

Paunches, gross.—Weight of stomachs as taken from the hogs.

Paunches, net.—Weight of stomachs cleaned.

Pig bags.—Refers to uteri.

[a] Bul. No. 48.

Slaughter tests of purebred hogs.

Breed.	Number of pigs.	Dressed meat.	Melts (spleen).	Heads.		Tongues.	Cheek meat.	Cheek-meat fat.	Leaf lard.	Kidneys.	Gullets.	Gullet fat.
				Gross.	Net.							
		Per cent.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Berkshire	10	76.20	3.00	105.00	85.00	8.00	10.00	2.00	40.00	3.00	12.00	0.50
	9	77.90	1.75	96.00	78.00	8.00	8.75	1.12	57.00	5.75	5.50	1.25
Average		77.04	.25	10.58	8.58	.84	.99	.16	5.11	.46	.92	.09
Tamworth	10	78.40	5.00	115.00	95.00	7.00	8.00	2.00	70.00	5.00	9.50	.50
	4	78.60	1.50	43.75	36.00	3.50	3.50	.75	15.00	3.00	2.50	.50
Average		78.46	.46	11.34	9.36	.75	.82	.20	6.07	.57	.86	.07
Chester White	9	78.40	4.00	98.00	75.00	5.00	6.00	2.00	55.00	3.00	9.50	.50
	8	77.80	1.50	78.75	65.00	5.75	6.50	1.50	45.00	4.50	5.25	1.75
Average		78.10	.32	10.40	8.24	.63	.74	.21	5.88	.44	.87	.13
Poland China	8	78.20	3.00	75.00	60.00	5.00	6.00	2.00	48.00	5.00	7.00	1.00
	9	79.00	2.50	84.25	70.00	6.00	7.00	1.25	48.00	5.00	6.00	1.50
Average		78.62	.32	9.37	7.65	.65	.77	.19	5.65	.59	.76	.15
Duroc Jersey	9	77.10	4.00	100.00	82.00	8.00	8.00	2.00	62.00	3.50	9.00	1.00
	9	77.00	2.12	86.00	70.00	6.25	7.25	2.25	41.00	5.00	6.50	3.50
Average		77.05	.34	10.34	8.45	.79	.85	.23	5.73	.48	.86	.25
Yorkshire	9	79.00	4.00	110.00	93.00	8.00	8.00	1.00	50.00	4.33	10.00	1.00
	4	79.60	1.25	42.25	35.00	3.25	3.25	.75	23.00	2.50	2.50	.50
Average		79.18	.40	11.71	9.85	.87	.87	.13	5.62	.53	.96	.11

Slaughter tests of purebred hogs—Continued.

Breed.	Ham facings.	Plucks.	Livers.	Hearts.	Lungs.	Bladders.	Bladders.		Bladder fat.	Total weight of guts.	Gut fat.	Cauler
							Gross.	Net.				
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pou*		*Pounds.*	*Pounds.*	*Pounds.*	*P*
Berkshire	4.00	64.00	32.00	6.00	15.00	.....			0.50	205.00	24.00	
	.....	50.50	25.00	5.50	20.00	0.			.....	218.00	31.00	
Average	.....	6.03	3.00	.61	1.84	.....	.....	.....	.....	22.26	2.90	3.08
Tamworth	4.00	60.00	26.00		18.00	.....	3.00	1.00	.50	200.00	30.00	25.00
	.....	24.75	11.00				.....	.....	.....	91.00	13.00	14.50
Average	.....	6.05	2.64					.....	.....	20.80	3.07	2.82
Chester White	4.00	50.00	25.00					1.00	.50	173.50	30.00	25.00
	.....	37.25	19.00					.....	.....	156.00	29.00	24.00
Average	.....	5.13	2.59					.....	.....	19.28	3.47	2.88
Poland China	4.00	50.00	27.00			.....		.50	.50	128.50	27.00	23.00
	10.50	44.25	27.00	4.75	12.50	1.00	.....	.....	.....	175.00	28.00	18.00
Average	.85	5.54	3.18	.57	1.32	.....	.....	.....	.....	17.85	3.24	2.41
Duroc Jersey	4.00	55.00	25.00	5.00	15.00	.....	2.00	.50	.50	189.00	25.00	29.00
	8.00	43.50	25.50	5.00	13.00	.75	.....	.....	.....	194.00	30.00	28.50
Average	.66	5.47	2.80	.56	1.56	.....	.....	.....	.....	21.28	3.05	3.20
Yorkshire	4.00	60.00	27.00	4.00	18.00	.....	4.00	1.00	.50	194.00	33.00	22.00
	.....	25.00	13.00	2.50	9.50	.50	.....	.....	.....	82.00	16.00	12.50
Average	.....	6.54	3.08	.50	2.12	.....	.....	.....	.....	21.23	3.77	2.65

Breed.	Bung guts.		Bung-gut fat.	Pig bags.	Small guts.		Stomachs.		Nutritive ratio.
	Gross.	Net.			Gross.	Net.	Gross.	Net.	
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Berkshire	7.00	5.00	10.00	3.00	40.00	25.00	15.00	12.00	1:5.6
	14.00	6.00	.....	2.25	34.00	19.00	21.00	14.00	1:7.1
Average	1.11	.58	.....	.28	3.90	2.32	1.90	1.37	
Tamworth	8.00	6.00	10.00	2.00	44.00	31.00	16.00	14.00	1:5.6
	7.50	3.00	.....	2.50	12.00	8.00	11.00	7.00	1:7.1
Average	1.11	.64	.....	.32	4.00	2.80	1.93	1.50	
Chester White	6.00	4.00	9.00	1.50	31.00	20.00	15.00	10.00	1:5.5
	10.00	4.00	.....	.75	25.00	15.00	15.00	11.00	1:7.1
Average	.98	.47	.....	.13	3.30	2.06	1.76	1.24	
Poland China	5.00	4.00	5.00	3.00	27.00	18.00	10.00	7.00	1:5.7
	15.00	5.00	.....	1.75	27.00	17.50	15.50	13.00	1:7.1
Average	1.18	.53	.....	.28	3.18	2.09	1.50	1.18	
Duroc Jersey	8.00	7.00	7.00	3.00	32.00	20.00	18.00	11.00	1:5.6
	14.75	6.75	.....	2.25	33.00	22.00	17.00	13.00	1:7.1
Average	1.27	.76	.....	.29	3.61	2.33	1.95	1.33	
Yorkshire	5.00	4.75	10.00	2.50	25.00	18.00	21.00	13.00	1:5.6
	7.00	3.00	.....	.50	14.00	8.00	7.00	6.00	1:7.1
Average	.92	.60	.....	.23	3.00	2.00	2.15	1.46	

The average of these tests shows the Yorkshire to be in the lead in dressed weight, the other breeds following in this order: Poland China, Tamworth, Chester White, Duroc Jersey, and Berkshire, the variation being from 79.18 per cent to 77.04 per cent.

Relative weights of vital organs.—The weight of vital organs is highly important. To ascertain what variations the Iowa[a] test showed in this respect the table below has been arranged. It shows the percentages of the weights of the vital organs to live weight for each breed in each experiment, with the average of both.

The average live weights of the hogs at the abattoir were as follows:

Average live weights of hogs of different breeds—Iowa experiments.

Breed.	1897.	1898.
	Lbs.	*Lbs.*
Berkshire	190	210
Tamworth	200	215
Chester White	177	181
Poland China	193	191
Duroc Jersey	202	190
Yorkshire	215	232

Relative weights of vital organs of purebred hogs.[a]

Breed.	Number of pigs.	Melts (spleen).	Tongues.	Kidneys.	Gullets.	Plucks.	Livers.	Hearts.
Berkshire:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Percent.*	*Per cent.*
First experiment	10	0.16	0.42	0.16	0.63	3.37	1.68	0.32
Second experiment	9	.09	.43	.31	.29	2.68	1.38	.30
Average		.13	.42	.23	.46	3.03	1.50	.31
Tamworth:								
First experiment	10	.25	.35	.25	.48	3.00	1.30	.40
Second experiment	4	.18	.41	.35	.29	2.88	1.28	.32
Average		.23	.37	.28	.42	2.97	1.29	.37
Chester White:								
First experiment	9	.25	.32	.19	.60	3.14	1.57	.32
Second experiment	8	.10	.40	.31	.36	2.57	1.31	.29
Average		.18	.35	.25	.49	2.87	1.45	.30
Poland China:								
First experiment	8	.20	.33	.33	.46	3.24	1.75	.33
Second experiment	9	.15	.35	.29	.35	2.58	1.57	.29
Average		.17	.34	.31	.40	2.89	1.66	.31
Duroc Jersey:								
First experiment	9	.22	.44	.19	.50	3.02	1.38	.28
Second experiment	9	.13	.38	.31	.40	2.68	1.57	.31
Average		.18	.41	.25	.45	2.86	1.47	.29
Yorkshire:								
First experiment	9	.20	.41	.22	.52	3.10	1.40	.20
Second experiment	4	.13	.35	.27	.27	2.69	1.40	.25
Average		.18	.40	.24	.44	2.97	1.40	.23

[a] Bul. No. 48, Iowa Expt. Sta.

Relative weights of vital organs of purebred hogs—Continued.

Breed.	Lungs.	Bladders.	Bladders, net.	Total weight of guts.	Bung guts, net.	Small guts, net.	Stomachs, net.
Berkshire:	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
First experiment	0.79	.....	0.05	10.79	0.26	1.32	0.63
Second experiment	1.10	0.03	.....	11.99	.33	1.04	.77
Average	.92	.....	.....	11.19	.29	1.16	.69
Tamworth:							
First experiment	.90	.....	.05	10.00	.30	1.55	.70
Second experiment	1.28	.06	.....	10.58	.35	.93	.81
Average	1.01	.....	.....	10.19	.31	1.37	.74
Chester White:							
First experiment	.62	.....	.06	10.89	.25	1.25	.62
Second experiment	.97	.07	.....	10.77	.28	1.04	.76
Average	.79	.....	.....	10.83	.26	1.15	.69
Poland China:							
First experiment	.65	.....	.03	8.32	.26	1.17	.46
Second experiment	.73	.04	.....	10.17	.29	1.02	.75
Average	.69	.....	.....	9.30	.28	1.09	.61
Duroc Jersey:							
First experiment	.83	.....	.11	10.44	.39	1.10	.60
Second experiment	.80	.44	.....	11.98	.42	1.36	.80
Average	.82	.....	.....	11.14	.40	1.22	.70
Yorkshire:							
First experiment	.93	.....	.20	10.03	.25	.93	.67
Second experiment	1.03	.06	.....	8.84	.32	.86	.64
Average	.96	.....	.....	9.65	.27	.91	.66

In the relative amounts of spleen there are only two variations from a general average—the Tamworths, with 0.23 per cent, and the Berkshires, with 0.13 per cent.

In weight of kidneys the Poland Chinas lead, with 0.31 per cent, the Berkshires being lowest, with 0.23 per cent.

There does not appear to be any particularly constant influence due to breed or type in the relative weights of those vital organs that constitute the pluck. The combined weights of liver, heart, and lungs should approximate that under the head of pluck; if, therefore, there is any influence of breed on the development and weights of these organs we should expect to find evidences of it in uniform and constant differences in weights. In the weight of plucks the Berkshires lead in the average, with 3.03 per cent, the Tamworth, Yorkshire, Poland China, Chester White, and Duroc Jersey following in the order named, the lowest weight being 2.86 per cent of the live weight. Yet, in relative weights of the organs that are included in the pluck, the Berkshires are but once in the lead—in the weight of the heart, where less variation is seen than in the weights of livers and lungs, the

Yorkshire being the only breed that shows much variation from the general average. The variation in weights of livers and lungs is quite erratic. Poland Chinas lead in relative weight of livers, with 1.66 per cent, the other breeds following thus: Berkshire, Chester White, Duroc Jersey, Yorkshire, and Tamworth, the least amount being 1.28 per cent of the live weight. The Tamworths lead in relative weight of lungs, with 1.01 per cent, the other breeds following in this order: Yorkshire, Berkshire, Duroc Jersey, Chester White, and Poland China, the lowest weight being 0.69 per cent of the live weight.

We find some appearance of uniformity in the weights of stomach and intestines. The heading "Total weight of guts" includes, among others, the three items that follow it. The Berkshires lead in this respect, with 11.19 per cent, the breeds following thus: Duroc Jersey, Chester White, Tamworth, Yorkshire, and Poland China, the lowest weight being 9.3 per cent of the live weight. The Duroc Jerseys lead in net weight of bung guts, with 0.4 per cent, the breeds following in this order: Tamworth, Berkshire, Poland China, Yorkshire, and Chester White, the lowest weight being 0.26 per cent of the live weight. The Tamworths lead in net weight of small guts, the weight being 1.37 per cent; the other breeds stand thus: Duroc Jersey, Berkshire, Chester White, Poland China, and Yorkshire, the lowest weight being 0.91 per cent. In net weight of stomachs the Tamworths lead, the breeds following in this order: Duroc Jersey, Berkshire, Chester White, Yorkshire, and Poland China, the weights ranging from 0.74 per cent to 0.61 per cent of the live weight. The record of the Berkshires and Duroc Jerseys is seen to be fairly uniform. Definite conclusions can not be drawn from these figures and it may be questioned whether, in the light of the facts concerning the feeding possibilities of the different breeds on similar rations, the improved breeds will show any marked and uniform differences in the relative weights of the internal organs when fed on the same feed.

Lard yield of different breeds.—By common consent, the name "lard hog" has been applied by many people to that type of animal the development of which has very largely been brought about on American soil, in contradistinction from the "bacon" type of hog which has been brought to us from Great Britain and Canada.

The writer is under obligation to Swift & Co., Chicago, who killed the hogs used in the Iowa experiments, for the following information regarding the lard yield of the different breeds in the test of 1898. Concerning their figures, they say:

> We did not, on any of the tests made, tank the fats of each lot separately, the amounts being too small. However, we know approximately what these fats should yield in rendered lard, and we have attached herewith a statement showing the different test lots slaughtered by us during November, 1898, and what we estimate the fats, etc., should yield in lard.
>
> For your information we beg to say that the ham facings, heads, cheek-meat fat, gullet fat, gut fat, caul and ruffle fat, bones, tails, feet, and fat trimmings are,

as a rule, tanked for lard by most packers, although at times some of the bones, tails, and pig feet are saved for offal trade and not rendered. The raw leaf also at times is saved for neutral and not rendered out as steam lard.

We have, however, in the table attached shown what all these fats and bones, if rendered out as lard, would amount to, as all these fats and bones go to make up the yield published by the Cincinnati Price Current, quoted by you.

* * * These yields are lighter than the averages shown by the Cincinnati Price Current and can be explained for the reason that all the hogs in these tests were made into English cuts, which invariably show a less yield in lard, on account of the smaller percentage of fats being tanked, than the same hogs would show if cut up as American cuts.

In estimating the yield of lard from the different fats, etc., the percentages of lard to actual weight for the various items are given as follows:

	Lard equivalent.
Ham facings	per cent.. 75
Heads, cheek-meat fat, gullet fat	do.... 35
Leaf lard	do.... 95
Bones and tails	do.... 17
Fat trimmings	do.... 75

The lard from the gut fat and the caul and ruffle fat is estimated at 2 per cent of the live weight.

The following table shows the calculations for all the hogs of the 1898 test for which a slaughter record was kept:

Lard yield of different breeds.

Breed.	Number of hogs.	Live weight.	Average live weight.	Ham facings.		Heads, cheek-meat fat, and gullet fat.		Leaf lard.	
				Weight.	Lard equivalent.	Weight.	Lard equivalent.	Weight.	Lard equivalent.
		Pounds	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Duroc Jersey	9	1,620	180	8	6	78.75	27.56	41	38.95
Poland China	9	1,720	191	10.5	7.87	72.75	25.46	48	45.60
Tamworth	4	860	215			37.25	13.03	15	14.25
Berkshire	9	1,880	209			80.37	28.13	57	54.15
Yorkshire	4	930	232			36.25	12.68	23	21.85
Chester White	8	1,450	181			68.25	23.88	45	42.75

Breed.	Number of hogs.	Gut, caul, and ruffle fat—Lard equivalent.	Bones and tails.		Fat trimmings.		Yield of total lard.	Average yield of lard.	Proportion of live weight.
			Weight.	Lard equivalent.	Weight.	Lard equivalent.			
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Per ct.*
Duroc Jersey	9	32.40	56.50	9.60	91.5	68.62	183.13	20.35	11.30
Poland China	9	34.40	59	10.03	103	77.25	200.61	22.29	11.66
Tamworth	4	17.20	39.50	6.71	56.5	42.37	93.56	23.39	10.88
Berkshire	9	37.60	67.25	11.43	103	77.25	208.56	23.17	11.09
Yorkshire	4	18.16	35.75	6.08	64	48	107.21	26.80	11.57
Chester White	8	19	53.25	9.05	88.5	66.37	161.05	20.13	11.11

INFLUENCE OF FEED ON THE CARCASS.

INFLUENCE OF WIDE AND NARROW RATIONS.

One of the earliest subjects for investigation in pork production was the influence of feed on the carcass. Following this line of study experiment-station workers have proved pretty accurately that, where a pig is fed a ration that is poor in those feed constituents whose function is to build up muscular fiber and is rich in carbohydrates, the carcass will probably show a development of fat at the expense of the lean meat (muscular fiber), and that, where a large proportion of protein is fed and a relatively small amount of carbohydrates, there is a correspondingly smaller development of fat and a larger development of muscular tissue and bone. Out of this came the ideas that instructed farmers to "feed for lean," or, rather, to strike a mean between rations and feed one that would supply fat, energy, and muscle-producing materials in the requisite proportions. The slaughter test early accompanied this branch of investigation, and from a mere estimation of the relative amounts of fat and lean has come to include the weighings of the internal organs and to involve chemical analyses.

The slaughter test was a feature of the experiments in Wisconsin and Iowa with wide and narrow rations that are discussed in the foregoing pages. The following tables show the data for the slaughterings in the actual and relative weights and the measurements of the parts.

The Wisconsin experiments.—The following table shows the slaughter test of the Wisconsin pigs that were fed a ration of ground pease, middlings, and milk in comparison with corn meal and milk:

Slaughter test of pigs fed a ration of ground pease and shorts, in comparison with corn meal.[a]

Breed.	Gain in eighteen weeks.	Live weight.	Dressed weight.	Dressed weight.	Blood.	Liver.	Kidney.	Intestines and stomach.	Length of body.	Length of small intestines.	Length of large intestines.	Intestinal fat.	Kidney fat.
Lot I. Corn meal and milk:	*Lbs.*	*Lbs.*	*Lbs.*	*P. ct.*	*Lbs.*	*Lbs.*	*Ozs.*	*Lbs.*	*Ins.*	*Ins.*	*Ins.*	*Lbs.*	*Lbs.*
Berkshire	190	270	218.0	80.74	7.1	3.7	6.0	19.7	43.0	789.0	216.0	6.3	12.1
Do	197	282	230.0	81.56	7.0	2.9	4.0	15.8	42.0	689.0	180.0	5.2	13.25
Yorkshire	115	177	131.0	74.00	6.2	.....	6.0	14.0	39.0	758.0	.....	3.0	7.0
Poland China	156	229	180.0	78.61	5.3	.....	5.0	14.5	41.0	730.0	204.0	3.0	8.0
Berkshire	143	227	187.0	82.37	6.1	2.7	6.0	16.7	39.0	786.0	174.0	3.6	7.5
Do	182	256	207.0	80.85	6.1	.7	6.0	18.7	42.0	789.0	.....	5.1	11.0
Poland China	214	300	230.0	79.66	7.0	.....	6.0	22.0	43.0	784.0	.....	4.3	12.0
Average	171	249	197.5	79.6	6.4	3.0	5.6	17.3	41.3	760.7	193.5	4.35	10.19

[a] Seventeenth An. Rpt., Wisconsin Expt. Sta.

***Slaughter test of pigs fed a ration of ground pease and shorts, etc.*—Continued.**

Breed.	Gain in eighteen weeks.	Live weight.	Dressed weight.	Dressed weight.	Blood.	Liver.	Kidney.	Intestines and stomach.	Length of body.	Lenth of small intestines.	Length of large intestines.	Intestinal fat.	Kidney fat.
Lot II. Ground pease, shorts, and milk:	*Lbs.*	*Lbs.*	*Lbs.*	*P. ct.*	*Lbs.*	*Lbs.*	*Ozs.*	*Lbs.*	*Ins.*	*Ins.*	*Ins.*	*Lbs.*	*Lbs.*
Poland China.	153	208	151	74.38	5.6	.....	6.0	19.5	38.0	702.0	.....	3.0	7.0
Do.....	95	167	128	76.69	7.3	.....	5.0	14.3	34.0	708.0	.....	2.3	2.5
Yorkshire.....	139	217	171	78.08	8.3	.....	7.0	22.5	40.0	799.0	240.0	3.3	7.0
Do.....	167	217	160	73.73	8.0	.....	5.0	24.0	43.0	720.0	.....	3.0	7.25
Poland China.	147	225	170	75.55	6.5	5.7	7.0	20.5	39.0	741.0	.....	3.7	10.0
Berkshire.....	168	241	200	82.98	8.8	4.5	6.0	20.0	41.0	678.0	180.0	3.4	8.8
Do.....	244	215	178	82.69	5.7	4.0	5.0	18.4	39.0	708.0	180.0	5.0	10.5
Do.....	158	223	191	86.03	7.2	3.9	7.0	20.0	40.0	802.0	.....	3.4	7.5
Average....	146	213	169	78.88	7.17	4.5	6.0	19.9	39.2	732.2	200.0	3.4	7.56

In this table it is found that the vital organs of the pigs on ground pease and middlings averaged heavier in proportion to their live weight than those on corn meal. These facts are best illustrated in the following table:

***Average actual and relative weights of blood, vital organs, and fat of pigs fed on wide and narrow rations.*[a]**

	Wide ration.		Narrow ration.	
	Pounds.	*Per cent.*	*Pounds.*	*Per cent.*
Live weight	249.00	100.00	213.0	100.00
Dressed weight	197.50	79.60	169.0	78.88
Blood	6.40	2.57	7.17	3.37
Liver	3.00	1.20	4.5	2.11
Kidneys	.35	.14	.375	.18
Intestines and stomach	17.30	6.95	19.9	9.34
Intestinal fat	4.35	1.75	3.4	1.60
Kidney fat	10.18	4.09	7.56	3.55

[a] Seventeenth An. Rpt., Wisconsin Expt. Sta.

We see that the pigs fed on pea meal, middlings, and skimmed milk developed very much more in the vital organs in proportion to their live body weight than those fed on corn meal and skimmed milk. The difference was most marked in the livers, where the relative weight for the narrow-ration pigs was almost twice as great as for the wide-ration pigs. The same proportion does not hold when the relative lengths of intestines to body lengths are compared. There is very little difference between the pigs of the two lots in this respect. The ratio of body length to that of the small intestine in the wide-ration pigs was 1:18.42; to that of the large intestine, 1:4.69. The ratio of body length to the length of small intestine of the narrow-ration pigs was 1:18.68; to that of the large intestine, 1:5.10.

follc able shows the slaughter test of the pigs fed pea eal and she n comparison with corn and rye meals:

aughter test of pigs fed a ration of pea meal and shorts in comparison with corn and rye meals.[a]

Breed.	Live weight.	Dressed weight.	Dressed weight.	Blood.	Intestines.	Spleen.	Liver.	Stomach.	Heart.	Intestinal fat.	Kidney fat.	Length of small intestines.	Length of large intestines.	Length of body.	Weight of kidneys.
I, corn and rye ls:	*Lbs.*	*Lbs.*	*P.ct.*	*Lbs.*	*Lbs.*	*Ozs.*	*Lbs.*	*Lbs.*	*Ozs.*	*Lbs.*	*Lbs.*	*Ins.*	*Ins.*	*Ins.*	*Ozs.*
)land China..	223.0	183.0	82.0	5.20	18.10	2.4	3.20	4.80	8.00	3.40	7.87	660.0	187.2	38.5	8.00
Yorkshire	208.0	162.0	77.8	5.40	17.30	4.0	[illegible]	[illegible].60	8.00	2.80	6.00	684.0	196.8	39.5	6.00
Berkshire.....	214.0	175.0	81.7	4.90	15.60	3.2	[illegible]	[illegible].10	8.00	2.70	8.50	615.0	180.0	38.0	8.00
Razorback-Po- land China...	244.0	195.0	79.9	6.40	17.50	4.8	[illegible]	[illegible].20	9.60	2.70	9.00	684.0	168.0	.....	10.00
Do.....	182.0	144.0	79.1	4.70	15.30	4.	[illegible]	[illegible].10	8.00	2.70	7.87	624.0	168.0	37.0	5.00
Average	212.2	171.8	80.1	5.32	16.76	3.6	[illegible]	[illegible].36	8.32	2.68	7.84	653.4	180.0	38.2	7.40
Lot II, pea meal and shorts:															
Berkshire.....	205.0	158.0	77.0	4.70	[illegible]	[illegible]	[illegible]	[illegible].10	6.40	2.50	5.50	615.0	184.8	37.0	6.25
Poland China..	179.0	140.0	78.2	5.30	[illegible]	[illegible]	[illegible]	[illegible].10	8.00	2.30	8.30	610.2	192.0	34.0	9.00
Razorback-Po- land China...	177.0	133.0	75.1	5.40	18	[illegible]	[illegible]	[illegible].60	6.40	2.70	6.50	607.2	184.8	33.5	8.00
Do.....	203.0	152.0	74.8	6.20	24.	[illegible]	[illegible]	[illegible].70	8.80	3.80	9.37	732.0	204.0	38.0	16.00
Average	191.0	145.6	76.2	5.40	16.57	4.0	3.66	4.62	7.40	2.82	7.41	641.1	188.4	35.5	9.86

[a] Eighteenth An. Rpt., Wisconsin Expt. Sta.

For the sake of uniformity the following table has been arranged from the Wisconsin figures to show the relative weights of blood, vital organs, and fat for the pigs of this experiment:

Average actual and relative amounts of blood, vital organs, and internal fat of pigs fed pea meal and shorts in comparison with corn and rye meals.[a]

	Wide ration.		Narrow ration.	
	Pounds.	*Per cent.*	*Pounds.*	*Per cent.*
Live weight	214.2	100	191	100
Dressed weight	171.8	80.1	145.6	76.2
Blood	5.32	2.48	5.4	2.83
Liver	2.98	1.39	3.66	1.92
Heart	.52	.24	.4625	.24
Stomach	4.36	2.04	4.62	2.42
Intestines	16.76	7.82	16.57	8.15
Kidneys	.4625	.22	.61625	.32
Spleen	.2375	.11	.25	.13
Intestinal fat	2.68	1.25	2.82	1.48
Kidney fat	7.84	3.66	7.41	3.88

[a] Eighteenth An. Rpt., Wisconsin Expt. Sta.

In this experiment the differences in the relative weights of the vital organs is evident, but is by no means as marked as it was in the experiment which compared corn meal and the mixture

and middlings. In fact, while the differences are uniformly in favor of the pigs fed a narrow ration, they are hardly large enough to be of moment in such a test. There was no difference in the relative weights of the hearts of the two lots. The relative length of body to length of intestines is still more contradictory in this test, being 1:19.68 and 1:5.43, respectively, for the small and large intestines of the wide-ration pigs; and 1:18.06 and 1:5.30, respectively, for the small and large intestines of the pigs fed the ration of pea meal and shorts. If it is true that a narrow ration has an influence on the development in weight and length of the vital organs, the fact that the rations were somewhat wider in this experiment than in the first one may have caused this result, although it is difficult to see what effect the widening could have had with one lot more than with another, because the increase in the ration was the same for both lots. A more reasonable explanation would be that the greater disparity in the variety of feed in the first experiment was the cause for the more pronounced development in the weight of the vital organs and blood. This experiment was the one that showed the advantage in feeding value of the narrower ration, which fact merely serves to complicate matters. A peculiar fact in this experiment is the greater accumulation of interna fat by the pigs on the narrow ration.

The following table shows the slaughter test of the pigs fed pea meal in comparison with corn meal:

Slaughter test of pigs fed a ration of corn meal in comparison with one of ground pease.[a]

Breed.	Live weight.	Dressed weight.	Dressed weight.	Blood.	Intestines.	Spleen.	Liver.	Heart.	Capacity of stomach.	Intestinal fat.	Kidney fat.	Length of small intestines.	Length of large intestines.	Length of body.	Weight of kidneys.
Lot I, ground peas:															
Razorback-Berkshire	*Lbs.* 171.0	*Lbs.* 130.0	*P. ct.* 76.0	*Lbs.* 4.40	*Lbs.* 13.70	*Ozs.* 4.00	*Lbs.* 2.20	*Ozs.* 8.00	*Lbs.* 9.20	*Lbs.* 3.10	*Lbs.* 7.125	*Ins.* 688.0	*Ins.* 180.0	*Ins.* 37.5	*Ozs.* 8.0
Yorkshire	189.0	144.0	76.5	5.80	15.80	3.20	3.20	6.40	8.30	1.90	8.250	600.0	222.0	36.0	6.0
Razorback	186.0	142.0	76.3	5.20	13.70	3.20	2.90	6.40	7.90	3.70	7.187	636.0	180.0	39.5	10.0
Razorback-Poland China	219.0	167.5	76.8	6.80	18.20	2.40	3.50	6.40	9.70	3.50	9.250	636.0	192.0	39.0	14.0
Razorback	191.0	151.0	79.0	6.10	13.00	4.80	2.40	6.40	10.10	4.70	9.593	666.0	174.0	39.5	10.0
Average	191.2	146.9	76.9	5.66	14.88	3.52	2.84	6.72	9.04	3.80	8.281	649.2	189.6	38.3	9.6
Lot II, corn meal:															
Razorback	147.0	120.0	80.0	4.00	9.80	4.00	2.10	6.40	7.80	3.00	7.187	536.0	144.0	38.5	6.0
Do	104.0	81.0	77.8	3.40	7.50	4.00	1.40	4.80	7.10	3.20	2.937	528.0	150.0	34.5	5.5
Yorkshire	188.0	147.0	76.5	4.90	13.40	1.60	2.30	4.80	9.90	1.20	8.000	640.0	198.0	37.0	7.0
Razorback-Poland China	237.0	193.0	80.0	5.60	15.50	3.20	2.80	8.00	9.10	4.70	9.250	660.0	192.0	42.5	14.0
Razorback-Berkshire	148.0	117.0	79.0	3.70	10.40	3.20	2.20	6.40	9.70	2.70	6.125	522.0	174.0	34.5	5.5
Average	164.8	131.6	78.6	4.32	11.32	3.20	2.16	6.08	8.72	2.96	6.700	577.2	171.6	37.4	7.8

[a] *Eighteenth An. Rpt.*, Wisconsin Expt. Sta.

The following table has been arranged from these figures in a similar manner as the foregoing ones and for the same reasons:

Average actual and relative amounts of blood, vital organs, and internal fat of pigs fed pea meal in comparison with corn meal.[a]

	Wide ration.		Narrow ration.	
	Pounds.	*Per cent.*	*Pounds.*	*Per cent.*
Live weight	164.8	100.0	191.2	100.0
Dressed weight	121.6	73.6	143.9	75.2
Blood	4.32	2.58	5.06	2.67
Liver	2.16	1.29	2.84	1.49
Heart	.86	.52	.42	.22
Capacity of stomach[b]	6.72	5.22	9.04	4.74
Intestines	11.32	6.78	14.86	7.80
Kidneys	.475	.28	.60	.31
Spleen	.20	.12	.28	.15
Intestinal fat	2.96	1.77	3.8	1.99
Kidney fat	6.70	4.01	8.261	4.32

[a] Eighteenth An. Rpt., Wisconsin Expt. Sta.

[b] The average capacity of the stomachs of the pigs in this experiment was determined "by emptying them of their natural contents and estimating the capacity of each by the number of pounds of water they would contain."—Eighteenth An. Rpt., p. 80, Wisconsin Expt. Sta.

These figures do not show quite the same uniformity in weights of vital organs as do the preceding ones. In the relative weight of hearts and capacity of stomachs, there is a slight difference in favor of the pigs on the wide ration, although the actual weights of these organs are greater in the case of the narrow-ration pigs. The ratios of body length to length of intestines, however, favored the narrow-ration lot, being 1:16.95 and 1:4.95, respectively, for the small intestine and large intestine of the pigs on pea meal, and 1:15.43 and 1:4.59, respectively, for the small intestine and large intestine of the pigs on corn meal. A large proportion of these pigs were razorbacks or razorback crosses. In this experiment there was also a greater accumulation of internal fat by the narrow-ration pigs than by those on the wide ration.

The Iowa experiments.—The pigs fed in a comparative test on wide and narrow rations at the Iowa Station were slaughtered at the close of the experiments and data compiled in the same manner as with those in the breed test. The following table shows the report of the packers on the slaughter test. It has been arranged so as to show the averages for both tests:

[End of Part II.]

Slaughter test of pigs fed on wide and narrow rations.[a]

Ration.	No. of pigs.	Dressed weight.	Melts (spleens).	Heads.		Tongues.	Cheek meat.	Cheek-meat fat.
				Gross.	Net.			
Wide ration:		*Per cent.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
First experiment	5	79.30	3.00	60.00	48.00	5.00	5.00	2.00
Second experiment	4	77.00	1.00	39.75	33.00	2.75	3.25	.75
Average per pig		78.28	.44	11.08	9.00	.86	.92	.31
Narrow ration:								
First experiment	5	77.10	2.00	50.50	40.00	5.00	5.00	.50
Second experiment	4	74.10	1.00	34.75	28.50	2.50	3.00	.75
Average per pig		75.77	.33	9.47	7.61	.83	.89	.14

Ration.	Leaf lard.	Kidneys.	Gullets.	Gullet fat.	Ham facings.	Plucks.	Livers.	Hearts.
Wide ration:	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
First experiment	40.00	2.00	5.67	0.33	4.00	31.00	15.00	4.00
Second experiment	19.00	2.25	2.50	.75	3.50	18.00	11.00	2.00
Average per pig	6.56	.47	.91	.12	.83	5.44	2.89	.67
Narrow ration:								
First experiment	41.00	2.00	5.50	.50	4.00	32.00	16.00	4.00
Second experiment	17.00	1.75	2.00	.50	1.75	16.00	11.00	1.75
Average per pig	6.44	.42	.83	.11	.64	5.33	3.00	.64

Ration.	Lungs.	Bladders.	Bladders.		Bladder fat.	Total weight of guts.	Gut fat.	Caul and ruffle.
			Gross.	Net.				
Wide ration:	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
First experiment	6.00	.....	1.50	0.50	0.50	100.00	30.00	18.00
Second experiment	5.00	0.50	.....	.....	.....	86.00	14.00	11.50
Average per pig	1.22	.....	.....	.....	.....	20.67	4.89	3.28
Narrow ration:								
First experiment	7.00	.....	1.50	.50	.50	124.00	22.00	16.00
Second experiment	3.50	.50	.....	.....	.....	90.00	7.00	10.25
Average per pig	1.17	.....	.....	.....	.....	23.78	3.22	2.92

Ration.	Bung guts.		Bung-gut fat.	Pig bags.	Small guts.		Stomachs.	
	Gross.	Net.			Gross.	Net.	Gross.	Net.
Wide ration:	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
First experiment	4.00	3.75	5.00	2.00	23.00	14.00	13.00	7.00
Second experiment	5.00	3.00	.....	1.25	14.00	8.00	8.00	5.50
Average per pig	1.00	.75	.....	.36	4.11	2.44	2.33	1.39
Narrow ration:								
First experiment	4.00	3.00	5.00	.50	24.00	12.00	13.00	6.00
Second experiment	8.75	6.00	.....	1.75	15.75	13.00	6.75	4.00
Average per pig	1.42	1.00	.....	.25	4.42	2.78	2.19	1.11

[a] Bul. No. 48, Iowa Expt. Sta.

The figures of the above table have been arranged in the following manner to show the results of the slaughter test in percentages:

Relative weights of vital organs of pigs fattened on narrow and wide rations.

Ration.	No. of pigs.	Melts (spleens).	Tongues.	Kidneys.	Gullets.	Plucks.	Livers.	Hearts.
		Per cent.	*Per cent.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per cent.*	*Per ct.*
Wide ration:								
First experiment	5	0.25	0.41	0.17	0.47	2.56	1.24	0.33
Second experiment.	4	.14	.39	.30	.36	2.57	1.37	.29
Average	-------	.21	.41	.22	.43	2.57	1.36	.32
Narrow ration:								
First experiment	5	.19	.47	.19	.51	2.99	1.50	.37
Second experiment.	4	.14	.37	.26	.29	2.33	1.60	.28
Average	-------	.17	.43	.22	.43	2.73	1.54	.33

Ration.	Lungs.	Bladders.	Bladders, net.	Total weight of guts.	Bung guts, net.	Small guts, net.	Stomachs, net.	Dressed weight.
	Per ct.	*Per cent.*	*Per cent.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per cent.*	*Per ct.*
Wide ration:								
First experiment	0.50	----------	0.04	8.26	0.31	1.16	0.58	79.3
Second experiment.	.71	0.07	----------	12.29	.43	1.14	.73	77.9
Average	.58	----------	----------	9.75	.35	1.15	.66	------
Narrow ration:								
First experiment	.65	----------	.05	10.65	.28	1.12	.56	77.1
Second experiment.	.50	.07	----------	13.08	.87	1.89	.58	74.1
Average	.60	----------	----------	12.19	.51	1.43	.57	------

This table shows the same tendency that has been remarked upon for pigs on a narrow ration to show greater relative weight of vital organs than those on a wide one. In relative weight of spleens and stomachs (net), those of wide-ration pigs are heavier; in the weight of kidneys and gullets the two lots are equal, and they are very nearly equal in relative weight of hearts. The great difference existing between the relative weights of the livers of the two lots gives a considerable advantage in relative weight of plucks to the narrow-ration pigs and the lead of the narrow-ration pigs in intestines gives them larger relative total weight of guts. The wide-ration pigs dressed out the greater weight of carcass.

The following table shows, from data furnished by Swift & Co., the actual and relative amounts of lard yielded by these pigs:

Lard yield of hogs fed narrow and wide rations.

Ration.	No. of pigs.	Live weight.		Ham facings.		Heads, cheek-meat fat, gullet fat.		Leaf lard.	
		Total.	Average.	Weight.	Lard equivalent.	Weight.	Lard equivalent.	Weight.	Lard equivalent.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Wide	4	700	175	3.75	2.62	34.50	12.07	19	18.05
Narrow	4	690	172	1.75	1.31	29.75	10.41	17	16.15

Lard yield of hogs fed narrow and wide rations—Continued.

Ration.	No. of pigs.	Gut fat, caul, and ruffle fat.	Bones and tails.		Fat trimmings.		Yield of lard.		Proportion of live weight.
		Lard equivalent.	Weight.	Lard equivalent.	Weight.	Lard equivalent.	Total.	Average.	
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Per cent.*
Wide	4	14.00	24.75	4.21	37.5	28.12	79.07	19.77	11.29
Narrow	4	13.80	21.75	3.69	37	27.75	73.11	18.28	10.59

This table shows results contrary to the last two Wisconsin experiments, whereas in the foregoing pages attention was called to the fact that the pigs fed narrow rations produced in two experiments more internal fat in proportion to live weight than similarly bred pigs on a wide ration. Here it must be noted that the wide-ration pigs produced 0.76 per cent more internal fat than those on the narrow ration. A point to be observed in connection with the Iowa experiments is that there was a very much greater variety of feed given than in the Wisconsin experiments, and that so far as variety of feed was concerned the conditions were practically the same for both lots now under consideration. In the first experiment the wide-ration pigs were given, during the feeding period of one hundred and fifty-three days, fourteen different feeds and the narrow-ration lot thirteen. In the second experiment the wide-ration pigs had, during a feeding period of one hundred and sixty-four days, nine different feeds, and those on the narrow ration ten. In the Wisconsin experiments the narrow-ration pigs that showed the greatest variation in relative weights of blood and vital organs compared with those on a wide ration, in the same test, received for one hundred and twenty-six days a ration of ground pease, wheat middlings, and skim milk, while the wide-ration pigs had corn meal and skim milk. In the other experiments neither lot was given an advantage in variety and two kinds of feed to each lot was the most allowed, the same feeds being given during the entire experiment.

In discussing results the Wisconsin Station investigators[a] point out that the pigs on wide rations generally dressed a larger percentage of the live weight than those on narrow rations, but that this larger relative amount of dressed weight was made at the expense of the weight of vital organs. Conversely, the greater weight of vital organs of the narrow-ration pigs was made at the expense of the dressed weight. The following comments on the Wisconsin results are interesting:

> It may be noticed that in the amount of blood, weight of intestines, and stomach, weight of livers, and weight of kidneys, the pea-fed lot has a greater average weight in every case than the corn-fed lot; and, as this is generally considered as

[a] Seventeenth An. Rpt., pp. 21–23.

comprising the most of the material making up the difference between dressed and live weight, the question naturally arises as to why there should not be a greater difference than the table shows in the average percentage of dressed meat to live weight between the two lots. This may be explained by stating that in dressing the carcasses of the two lots it was noticed that there was apparently somewhat of a "dropsical" condition in nearly all of the pigs of the corn-fed lot; i. e., there was quite a large quantity of fluid in the abdominal cavity, which was not to be found, in such quantities at least, in those fed on pease and middlings.

The following quotation suggests the possibility that long-continued feeding exclusively on a very wide ration, such as corn, may lower vitality and render the animal less able to resist disease:[a]

Further study of the table discloses the fact that this increased percentage of dressed meat to live weight is the outcome of a proportionately smaller percentage of blood and heart, kidneys, liver, spleen, stomach, intestines, and other internal organs that have to do with the vital functions of the animal. It may be that this increased percentage of dressed meat has been secured at the expense of the vitalizing forces of the animal, leaving it impoverished in those respects to a degree that may go far to explain the great prevalence of hog cholera and other diseases that are so common and so extremely fatal in those sections where the hogs are fed mainly corn.

INFLUENCE OF TANKAGE ON THE CARCASS.

When the Indiana experiments with tankage closed, 2 pigs in each lot were slaughtered and the various parts of the body weighed.[b] The expected difference in weight of vital organs of the tankage-fed hogs as compared with those fed on corn was not very apparent. A corn-fed pig weighing 182 pounds yielded 4½ pounds of blood, which was the same as that of a pig weighing 195 pounds fed the smaller tankage ration (Lot I) and only 2 ounces more than a 150-pound pig from the lot fed on corn meal, shorts, and tankage. There was no difference in either weight or length of small intestines due to feeding the highly nitrogenous feed. The pig showing the greatest length of small intestines (65 feet 4 inches) was fed on corn, the next greatest length of small intestine being 60½ feet from a tankage-fed pig. The only difference in the digestive organs that could be charged to the feed was the condition of the stomachs in the corn-fed lot. These were filled with "sour, offensive-smelling corn meal," and the contents of one of them weighed 11 pounds 4 ounces, while the next greater weight of stomach contents was 6 pounds 5 ounces, found in the case of a pig on corn meal, shorts, and tankage. This apparently sour, abnormal condition of the contents of the stomachs was not particularly marked with the tankage-fed pigs.

When the carcasses were cooled and cut up, the only appreciable difference that could be traced to the feed was a somewhat greater accumulation of internal fat in the corn-fed pigs, and the flesh was

[a] Eighteenth An. Rpt., p. 33, Wisconsin Expt. Sta.
[b] Bul. No. 90, Indiana Expt. Sta.

somewhat less firm than that of the tankage-fed carcasses. Feeding tankage did not show a marked influence on the relative amount of lean meat, but this feature was very plainly influenced by the breed. Half the pigs were Berkshires and half Poland Chinas. The Berkshire carcasses showed relatively more lean meat than the Poland China carcasses, and in every instance the depth of fat on the back was less in the carcasses of the Berkshires than in those of the Poland Chinas.

INFLUENCE OF FEED ON EXTERIOR FAT.

The preceding figures show mainly the influence of feed on the internal organs. The following show the effect of various rations as evidenced by the thickness of fat on the loin, back, and shoulders. These results were obtained at the Wisconsin Experiment Station[a] in connection with slaughter tests already noted:

Thickness of exterior fat of pigs fed wide and narrow rations.

Ration and breeding.	Loin.	Back.	Shoulder.
Corn and rye meals:	*Inches.*	*Inches.*	*Inches.*
Poland China	1.75	2.5	2.75
Yorkshire	1.37	1.5	2.25
Berkshire	1.75	2.12	2.37
Razorback-Poland China	1.75	2.5	3.00
Do	1.12	2.0	2.12
Average	1.54	2.12	2.49
Pea meal and shorts:			
Berkshire	1.25	1.62	1.75
Poland China	1.37	1.75	2.12
Razorback-Poland China	.88	1.62	2.00
Do	1.25	1.75	2.00
Average	1.16	1.68	1.96
Pea meal:			
Razorback-Berkshire	1.5	1.625	2.00
Small Yorkshire	1.375	1.875	2.75
Razorback	1.875	2.0	1.375
Razorback-Poland China	2.0	2.0	3.00
Razorback	2.25	2.375	2.75
Average	1.8	1.975	2.175
Corn meal:			
Razorback	2.0	2.125	3.00
Do	1.125	1.25	1.75
Small Yorkshire	2.125	2.125	3.00
Razorback-Poland China	3.00	2.75	3.50
Razorback-Berkshire	1.75	2.0	2.50
Average	2.0	2.05	2.55

[a] Eighteenth An. Rpt.

The following table presents the averages of the foregoing:

Average thickness of exterior fat of pigs fed wide and narrow rations.

Ration.	Loin.	Back.	Shoulder.
Wide ration:	*Inches.*	*Inches.*	*Inches.*
Corn and rye meals	1.54	2.12	2.6
Corn meal	2.00	2.05	2.5
Narrow ration:			
Pea meal and shorts	1.16	1.68	1.9
Pea meal	1.8	1.975	2.175

The influence of these rations on the exterior fat is very marked. In each case where a narrow ration was fed, the fat of the loin, back, and shoulder was less than where a wide ration was fed. To go more into details, where pea meal and shorts were fed in comparison with corn meal and rye meal, the thickness of fat on the loin, back, and shoulder was 1.16 inches, 1.68 inches, and 1.96 inches, respectively, in the pigs fed on the narrow ration; and the same measurements of the pigs fed corn meal and rye meal were 1.54 inches, 2.12 inches, and 2.49 inches, respectively. The difference in thickness of fat between the pigs fed pea meal in comparison with corn meal was not so great as in the other experiment. The thickness of loin, back, and shoulders of the pea-fed pigs was 1.8 inches, 1.975 inches, and 2.175 inches, respectively—considerably more in all cases than those measurements for the pigs on pea meal and shorts, although the nutritive ratio of the pease was less than that of the ration of pea meal and shorts. These measurements of the pigs fed corn meal were, respectively, 2 inches, 2.05 inches, and 2.55 inches. Although there was an excess over the pigs fed corn meal and rye meal, except in the thickness of fat on the back, the difference in these measurements between the pigs fed corn meal and those fed pea meal is less in all respects than the same measurements between the pigs fed corn meal and rye meal and those fed pea meal and shorts.

The respective influences of breed and feed are very well marked, as shown in the large table. As an example of the predominance of breed influence, the Yorkshire in the lot fed corn meal and rye meal and the Poland China in the lot on pea meal and shorts are interesting. The Yorkshire had a thickness of fat over loin, back, and shoulder of 1.37 inches, 1.5 inches, and 2.25 inches, respectively—considerably below the average for the lot; the Poland China in the narrow-ration lot measured 1.37 inches, 1.75 inches, and 2.12 inches, respectively, at these points—considerably above the average of the lot. On the other hand, a very interesting instance of the predominance of the influence of feed is seen in the case of the small Yorkshire in the lot fed corn meal, which measured 2.125 inches,

2.125 inches, and 3 inches, respectively, over loin, back, and shoulder, standing second in the lot in this respect and well above the average.

EFFECT OF FEED ON STRENGTH OF BONES.

In the two experiments[a], of which the foregoing results are a part, tests were made to ascertain the breaking strength of thigh and hind pastern bones and the influence of different means of feeding on this. The following results were obtained:

Breaking strength of bones.

Ration and breeding.	Thigh.	Hind pastern.
Corn and rye meals:	*Pounds.*	*Pounds.*
Poland China	930.0	232.0
Yorkshire	886.0	175.0
Berkshire	748.0	277.0
Razorback-Poland China	1,050.0	384.0
Do	727.0	204.0
Average	868.0	254.0
Corn meal:		
Razorback	456.0	234.0
Razorback	610.0	170.0
Yorkshire	720.0	248.0
Razorback-Poland China	1,027.0	273.0
Razorback-Berkshire	583.0	219.0
Average	679.2	242.0
Pea meal and shorts:		
Berkshire	816.0	274.0
Poland China	862.0	240.0
Razorback-Poland China	762.0	174.0
Do	859.0	306.0
Average	829.0	249.0
Pea meal:		
Razorback-Berkshire	642.0	375.0
Yorkshire	791.0	370.0
Razorback	793.0	360.0
Razorback-Poland China	1,260.0	343.0
Razorback	823.0	340.0
Average	861.8	357.6

These figures show a greater breaking strength of thigh and hind pastern bones in the wide-ration pigs fed on corn and rye meals than those fed otherwise. In the experiment with pea meal and corn meal, however, the breaking strength of these bones was much higher in the narrow-ration lot than in those fattened on a wide ration.

[a] Eighteenth An. Rpt., Wisconsin Expt. Sta.

Carlyle and McConnell[a] calculated the breaking strength of the bones for each 100 pounds of carcass weight, and their results are given in the following table:

Breaking strength of bones per 100 pounds carcass weight.

Ration.	Thigh.	Hind pastern.
	Pounds.	*Pounds.*
Corn and rye meals	504.0	146.6
Corn meal	530.4	130.2
Pea meal and shorts	568	169
Pea meal	579.4	265.2

When we consider the breaking strength of the bones in relation to the weight of carcass, there is a very manifest advantage in favor of the narrow ration, the bones of the pigs on pea meal alone breaking at a higher point than those of the pigs on pea meal and shorts, and the bones of the pigs on corn meal alone breaking at a higher point than those of the pigs on corn meal and rye meal.

FEEDING FOR PRIME BACON.

One of the branches of the hog industry to which it would seem profitable for farmers in the United States to pay more attention than in the past is the production of bacon for the English market. Most United States export product goes to Great Britain, and it forms the greater part of the bacon imported by that country, but it has never equaled the Danish bacon in price, and in this respect it has generally been behind the bacon imported from Canada also. While American bacon is said to have a better standing on this market at present than in former years, we can hardly yet claim superiority for it; and whatever advance in quality has been made must be attributed rather to the enterprise of the packers than to increased skill on the part of the breeder or the feeder.

Canadian farmers depend upon their exports of bacon to a very great extent, and its maintenance is a source of solicitude. Day, at the Ontario Agricultural College, and Grisdale and Shutt, at the Central Experiment Farm, have studied the production of export bacon during the past eight years to ascertain the best methods of feeding and breeding, and also the prevention of deleterious properties in the bacon produced.

REQUIREMENTS OF THE ENGLISH BACON TRADE.

At the outset of his studies Day[b] obtained data concerning the requirements of packers for the bacon exported to Great Britain.

[a] Eighteenth An. Rpt., Wisconsin Expt. Sta.

[b] An. Rpt., 1896, pp. 74–77, Ontario Agricultural College.

The following statement from J. W. Flavelle, of Toronto, an authority on this subject, explains these requirements and the qualifications of different breeds to meet them, according to the information at the time of writing:

The English market for Wiltshire sides is in a general way divided, first in relation to the fatness or leanness of a side, and second as to its size.

The most desirable hog is one which will make a side weighing from 42 pounds to 55 pounds. If it be made from a hog with the fat even down the back, and not too much of it, and a good thick belly, it will grade as No. 1 selection. If the back be too stout, with perhaps only the extra fat bowed up on the shoulder, it may go into what we call No. 2 selection. This No. 2 selection is purely regulated by the fatness of the side. If it is extra stout, it goes forward as "fat." The value of a No. 2 side fluctuates very greatly. Sometimes, when the market is in a peculiarly active condition, No. 2 sides will sell almost on a parity with No. 1. The greatest difference is from 2 to 8 shillings, with perhaps an average through the year of 4 shillings per hundredweight. Heavier sides weighing, say from 60 pounds to 70 pounds, even if lean, often bear a severe reduction in price, while if they are fat we have known the difference to reach the extreme point of 12 shillings per hundredweight, although this, of course, is a very rare case.[a]

* * * * * * *

The value of hogs, like your Chester White, Duroc Jersey, and Poland China, is largely determined by the season of the year in which they are marketed. The sections from which these come the most freely (Essex and Kent) have always catered to the dressed-hog trade and have been in the habit, prior to eighteen months ago [about 1895], of marketing their hogs almost exclusively during the winter months. These hogs were marketed at a time when the export business was the worst—the winter trade always recording lower prices in England than the summer, hence these hogs have sold for dressed-hog purposes fairly well up to desirable Wiltshire stock. We are, however, as exporters, gradually pulling away from them even in winter time, and to-day we are paying for prime lean hogs up to 200 pounds 4 cents, while for fat hogs, and hogs over 200 pounds, we are only paying 3½ cents.

Mr. Flavelle states, in reporting on the pigs of a breed test of 1896, that with the possible exception of 1 each of the Duroc Jersey, Poland China, and Chester White breeds, all the pigs of these breeds would go into the 3½-cent class. These 3 were excepted on account of being "sizable," "showing some evidence of flesh," although, strictly speaking, they would be thrown out. One Yorkshire and 2 Berkshires would go into the 3½-cent class. The Tamworths were all classed as No. 1 selection, but one was faulty from being fed too long. He advises the development of a hog for the Canadian export trade which shall be well fleshed, deep in side, with a well-proportioned ham and shoulder, and marketed at a weight of 165 to 190 pounds. Care is advised to get an animal with a good thick belly, and one that will fatten evenly on the back and carry a side very even throughout. He states that the criticism to which Canadian sides are subject on

[a] In a later report Day defines Wiltshire bacon as "made from well-fed hogs, weighing from 160 to 200 pounds live weight. 'Cumberland bacon' is made from lighter and generally leaner hogs, and the side is cut differently."—Ontario Agricultural College An. Rpt., 1898, p. 88.

English markets, when compared with Irish and Danish sides, is that the Canadian side "ran off in the loin and ham." There was too much shoulder development as compared with that of the ham.

SOFT BACON.

The greatest obstacle with which Canadian bacon curers have to contend is the tendency of the bacon to become soft in curing. The Canadian packer finds an "inordinate quantity of soft bacon" in the product of hogs purchased in May, June, and part of July.[a] The nature of this trouble, its causes and prevention, have been studied very extensively by Canadian experimenters. Day states that soft bacon does not necessarily mean fat bacon; on the contrary, softness is more likely to develop in hogs that are lean and underfed than in those that have been well fed and are fat. This statement is borne out by the report of the packer on the pigs fed in 1898 that the Cumberland sides in all lots showed more tendency to softness than the Wiltshires, although they were not of the same breed nor were they fed similarly.[b] Again the packer's report states:

> It was very noticeable that the sides which turned out soft invariably belonged to hogs that were manifestly unfinished. Without exception, the backs of the soft sides were thin (usually less than three-fourths of an inch in thickness) and in general pointed not so much to lack of weight, but rather to the hogs having been marketed before they were in a marketable condition. This is also true in a wider way according to our experience. The bulk of soft sides in our house come from No. 3 and No. 4 selection, which classes comprise the light weights.[c]

Day says:[a]

> Where the tenderness is barely noticeable, the bacon may still pass as No. 1 selection; when there is decided tenderness, it must go into a cheaper grade; but a really soft side is of little value.

According to Day—[a]

> Softness develops while the bacon is in the salt, and when taken out of the salt the fat is soft and spongy, the value of the bacon being reduced according to the degree of softness.

According to Shutt,[d] softness is readily perceptible to the touch and visibly noticeable when firm and soft sides are hung on the hooks, the "drag" of the soft sides being much greater than that of the firm ones. Its effects are also seen when firm and soft sides are lifted from a table by either end, the firm side remaining fairly straight and the soft one doubling over.

The nature of softness.—At the Central Experimental Farm, Shutt[e] conducted exhaustive studies during two years to study the nature, cause, and prevention of softness in bacon. He found that the soft characteristic was due to the presence of a large proportion of liquid

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[a] An. Rpt., 1898, p. 88, Ontario Agricultural College.
[b] An. Rpt., 1898, Ontario Agricultural College.
[c] An. Rpt., 1901, p. 59, Ontario Agricultural College.
[d] Bul. No. 38, p. 8, Central Experimental Farm.
[e] Bul. No. 38.

fats, principally olein, in the fatty tissue of the pork. Animal fats are generally composed mainly of three fatty compounds—palmitin, stearin, and olein, of which olein constitutes the greatest part of the fat of swine. Of these, palmitin and stearin are solid at ordinary temperatures, but olein is a liquid or fluid fat at ordinary temperatures, and it is readily apparent that the greater the proportion of olein in fat the softer it will be, and, conversely, the greater the proportion of palmitin and stearin the firmer the fat will be.

The fatty tissues from 2 Wiltshire sides was analyzed; one was firm and of good quality, weighing 46 pounds, and the other, weighing 44 pounds, was soft and of very inferior quality. Samples were taken by cutting into the sides immediately in front of the thigh joint (socket of the femur in the pelvic arch) and immediately in front of the first rib, this being done to offset any possible differences in the composition of the fat due to its location; the one sample was designated "loin," the other "shoulder." The following table shows the composition of fatty tissue in these samples:

Composition of fatty tissue in firm and soft bacon. (Shutt.)

	Firm.		Soft.	
	Loin.	Shoulder.	Loin.	Shoulder.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Water	15.56	6.53	12.50	2.67
Salt	2.73	1.12	1.84	.48
Nitrogen	.504	.285	.243	.142
Fiber (nitrogenous matter)	3.15	1.78	1.52	.89
Fat	78.56	90.57	84.27	95.96
Olein in bacon	50.05	58.33	66.37	76.94
Palmitin and stearin in bacon	28.51	52.24	17.90	19.02

The term "olein" used in these experiments includes not only olein, but all fluid fats present in the fatty tissue of the pork analyzed. As the final effect of all fluid fats on the consistency of the fatty tissue was held to be similar, this method rendered the calculations much less complex. To show the relative amounts of fluid to solid fats, the pure fats were analyzed and the ratio of solid to fluid fats calculated, with the results shown in the following table:

Composition of fat from firm and soft bacon. (Shutt.)

	Firm.		Soft.	
	Loin.	Shoulder.	Loin.	Shoulder.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Olein (calculated)	63.71	64.40	79.95	80.18
Palmitin and stearin	36.29	35.60	20.05	19.82
Ratio of palmitin and stearin to olein	1:1.76	1:1.80	1:3.99	1:4.02

These figures show a much larger percentage of olein in the firm pork than in the soft, being about 64 per cent in the former and 80 per cent in the latter. The greater amount of olein in the soft pork is accompanied by a corresponding decrease in the relative amount of palmitin and stearin present. The proportion of the solid to fluid fats was about 1:1.78 in the firm side and 1:4 in the soft side. Shutt[a] ascribes the cause of soft pork to this large proportion of fluid fats, and uses the estimation of the olein as "a ready means of tracing the effect of any particular food or condition on the pork produced."

The following table shows physical and chemical constants of the fat from firm and soft bacon:

Physical and chemical constants of fat from firm and soft bacon. (Shutt.)

	Firm.		Soft.	
	Loin.	Shoulder.	Loin.	Shoulder.
Melting point	37.6° C.	37.75° C.	27.4° C.	28.2° C.
Specific gravity at 96° C	.8668	.8859	.8678	.8740
Specific gravity at 100° F	.9009	.8980	.8970	.8988
Saponification equivalent	285.3	282.3	287.3	286
Reichert number	.408	.714	.408	.663
Iodine absorbed	55.3	55.9	69.4	69.6

Standards of firmness.—As no investigation of this nature could be carried on without standards of excellence for the bacon analyzed, a tentative scale was agreed upon. A factory standard was adopted ranging from 100 downward. The quality of the bacon was determined by feeling and running the finger down the fat surface of the back of a cut side, the "hardest and most resistant to pressure" being rated at 100.[b] Oiliness was particularly noted, and it is stated that "there were but few cases in which the softness (slight resistance to pressure) was not accompanied with this quality."[c] Thickness of fat and shape of carcass were also considered in making the factory ratings. The factory scale was as follows:

Very firm	85 to 100
Firm	75 to 85
Moderately firm	70 to 75
Soft	50 to 70
Very soft	less than 50

There were many objections to the use of the factory rating as the sole means of determining the amount of softness. The ratings were not so accurate, for many reasons, as was desired. The element of error in calculation, the effect of low temperatures in winter (when artificial refrigeration is unnecessary at Ottawa), making the pork appear firmer than it really was, and of high temperatures in sum-

[a] Bul. No. 38, p. 9, Central Experimental Farm.
[b] Bul. No. 38, p. 11, Central Experimental Farm.
[c] Loc. cit.

mer, making the bacon appear softer than it really was, led to the use of the olein content as the principal means of rating the softness of the pork. Unless the greatest care is taken in making the factory ratings, Shutt regards them "of little save corroborative value."[a]

The approximate percentages of olein corresponding to the factory ratings are given as follows:

	Percentage of olein.
Very firm	68 or less
Firm	68 to 71
Moderately firm	71 to 73
Soft	73 to 75
Very soft	75 and above

The greater accuracy of the olein content as the indicator of softness is shown by the fact that on factory inspection carcasses were frequently rated as "very firm" and "firm" that were shown by the olein content to be "soft" and "very soft." On the other hand, very few carcasses were rated lower by the factory inspection than by the determination of olein present.[b] In his discussion of the second series of experiments, Shutt states that "very frequently examination after smoking the bacon has confirmed the lower olein values."[c]

THE CAUSE OF SOFT PORK.

There have been many theories as to the cause of soft pork. It has been ascribed to breed, feed, age of the pig, the exercise allowed, the section of the country in which the pig is raised, the season of the year when slaughtered, etc. Shutt[b] states:

> Many theories have been advanced to account for softness in pork. Some have ascribed it to the character of the food, others to undue forcing of the pig in the earlier stages of growth, to killing the pig while in heat, to slaughtering while still immature, or unripe, to the breed of the pig, to the locality or district in which the pig is grown, and even the phase of the moon when the pig is slaughtered has been assigned as a cause.

Of all these influences, the ones that have been especially investigated have been maturity of the animals, the character of the feed and its methods of preparation, exercise, locality where produced, and breed.

Day's[d] investigations soon showed that the influence of breed was of little or no consequence. Firm bacon from pigs of the lard type and soft bacon from pigs of the bacon type showed that, so far as the firmness of bacon was concerned, methods of feeding and manage-

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[a] Bul. No. 38, p. 11, Central Experimental Farm.

[b] Bul. No. 38, p. 12, Central Experimental Farm.

[c] Bul. No. 38, p. 32, Central Experimental Farm.

[d] The reader should observe that the relative firmness of a side of bacon has little or nothing to do with the relative amount of lean meat and fat. The latter factor is undoubtedly the result of breed influence to some extent.

ment were of more importance than the question of breed. Experimenters studying the causes of soft pork are therefore disregarding the breed question to a certain extent and are only taking pains to select animals that are of pronounced bacon type. At the Ontario Agricultural College, Day fed pigs on various rations to study the effect of feed and exercise on the firmness of bacon.

At the Central Experimental Farm, Shutt's investigations covered two years. In the first year's work, about 180 Tamworth or Tamworth grade pigs were fed, the experiment commencing in May, 1899, when the pigs were one to two months old, and closing May 28, 1900. The work of this year was devoted to the effect of character and preparation of feed and methods of feeding, maturity at slaughtering, exercise, and locality where raised. Twenty lots were fed, in six of which the feeding was divided into two periods, the first period including the feeding until the pigs had attained a weight of 100 pounds and the second period included feeding after that weight. This was done to ascertain the effects of different rations at various stages of growth, as it was thought that feeding in the earlier stages a ration that was supposed to have a beneficial effect might mitigate the effects during the latter part of the fattening of one that was known to be injurious, and, conversely, to ascertain whether a beneficial ration fed to pigs during the latter stages of the experiment would offset the injurious effect of an earlier feed. This was proceeding on the theory that Day used when he fed pigs skim milk up to a weight of about 100 pounds, or allowed exercise, and discontinued such treatment after attaining this weight, and vice versa. The methods of studying the effects of immaturity and the results therefrom have already been given. To study the effects of exercise, the animals on each ration were divided into two lots, one being "in small paddocks containing shanties or shelters," the other "in a pen of the piggery, each pen having a small yard attached." To study the effect of locality on quality of bacon, half the pigs on all but three rations were from western Ontario (Essex and Kent counties) whence packers claimed to receive most of their soft bacon, and half were from eastern Ontario (Carleton County).

Each ration was given in both "limited" and "unlimited" amounts. "Where not otherwise stated, a sufficiency of green fodder, usually pease and oats, in addition to the grain ration, was given to keep the animals in a thrifty condition." This was done because it was generally recognized that these feeds induced a thrifty growth and that thrift during life has much to do with the quality of the bacon.

INFLUENCE OF MATURITY ON FIRMNESS OF BACON.

Day's conclusions on the influence of maturity on the firmness of bacon have been already referred to. Shutt's results on this phase of

the subject follow. (See p. 208.) During the preliminary investigations 4 pigs that had been weaned but a short time were killed and the olein content and melting point ascertained. The following table shows these results:

Immature pork—composition and melting point. (Shutt.) [a]

Locality.	Dressed weight.	Olein.		Ratio of palmitin and stearin to olein.		Melting point.	
		Shoulder.	Loin.	Shoulder.	Loin.	Shoulder.	Loin.
	Pounds.	*Per cent.*	*Per cent.*			*° C.*	*° C.*
Western Ontario	27	90.6	88.2	1:9.6	1:7.5	25.2	24.4
Do	23	86.9	85.9	1:6.5	1:6.1	24.5	25.7
Eastern Ontario	42	83.3	82.2	1:4.9	1:4.6	27.6	28.5
Do	30	73.3	72.9	1:2.7	1:2.7	29.8	32.0

[a] Bul. No. 38, p. 10, Central Experimental Farm.

Comparing these results with those of the firm pork (p. 209), this immature pork is seen to be much higher in olein content, the ratio of palmitin and stearin to olein less, and the melting point lower. It was regarded as noteworthy that the showing of the pigs from eastern Ontario was much better than those from the western counties.

As one phase of his work in 1899, the first year of his investigations, Shutt killed 2 pigs in each lot when they had attained a weight of 100 pounds and examined them for olein content and melting point of fat, thus obtaining more complete data on the effect of immaturity on the firmness of the bacon produced. "Maturity" was considered to be a weight of 175 to 200 pounds. The following table shows these results:

Relative amount of olein [a] *in fat of immature pigs. (Shutt.)* [b]

Ration.	Eastern.	Western.	Mean.
	Per cent.	*Per cent.*	*Per cent.*
Corn meal ¼, oats, pease, and barley equal parts ¼; boiled; unlimited	[c]77.1	[c]91.6	84.3
Corn meal, oats ¼, pease, and barley equal parts ¼; boiled; limited	79.2	.....	.....
Corn meal ¼, oats, pease, and barley equal parts ¼; dry; unlimited	83	87.1	85
Corn meal ¼, oats, pease, and barley equal parts ¼; dry; limited	75	83.5	79.3
Corn meal; dry; unlimited	87.2	85.6	86.4
Oats, pease, and barley, equal parts; dry; unlimited	80.9	83.6	82.1
Corn meal; soaked; unlimited	85.7	88.4	87
Oats, pease, and barley, equal parts; soaked; unlimited	71.9	77	74.4
Beans 1 part, shorts ¼ part	[c]83.9	.....	.....

[a] As the fat from shoulder and loin differed so little in olein content, the results of the analyses of the fat from these points were averaged.

[b] Bul. No. 38, p. 16, Central Experimental Farm.

[c] One pig only.

These results also show much higher figures for young pigs than have already been noted as characteristic of firm pork. The difference is very pronounced. The analysis of firm bacon gave the relative

amount of olein as about 64 per cent. Here the smallest amount of olein is 71.9 per cent in the case of eastern Ontario pigs which were fed an unlimited ration of equal parts of oats, pease, and barley, soaked. The high olein content of the pigs fed corn and beans should be noted, as should also that of the pigs from western Ontario. Shutt[a] regards these results as furnishing "undoubted proof of the soft character of the fat of young pigs."

INFLUENCE OF FEED AND MANAGEMENT ON THE FIRMNESS OF BACON.

RESULTS AT GUELPH.

The following table shows Day's[b] results in studying, in 1898, the influence of feed and management on the firmness of bacon. It includes results with pigs on various feeds and fed under various conditions. The factors studied were the kind of feed, method of feeding, and exercise. The pigs in the first three groups were purchased in September, and had been running on a stubble field for about six weeks. Groups IV, V, and VI were kept in pens from the time of weaning. The pigs of the last three lots were purebreds that had been in an experiment designed to show the effects of whey and exercise. After the pigs were slaughtered, packing-house inspections of the bacon were made, and these reports are included in the last column of the following table:

Condition of bacon produced by various methods of feeding.

Description of groups and methods of feeding.	Condition of bacon.
Group I: 8 sides. Hogs had been running on stubble fields. Average weight at commencement of experiment, 118 pounds. Fed six weeks on corn meal and rape.	Wiltshires: 8 sides firm.
Group II: 8 sides. Same previous treatment as Group I. Average weight at beginning of experiment, 107 pounds. Fed six weeks on corn meal.	Wiltshires: 6 sides firm. Cumberlands: 2 sides firm.
Group III: 8 sides. Same previous treatment as Group I. Average weight at beginning of experiment, 104 pounds. Fed six weeks on pease, barley, and shorts.	Wiltshires: 4 sides firm. Cumberlands: 2 sides firm, 2 sides tender.
Group IV: 8 sides. Hogs had no outdoor exercise from time of weaning. Previous to experiment were fed wheat middlings and shorts, with skimmed milk. Average weight at beginning of experiment, 100 pounds. Fed six weeks on pease, barley, and shorts, with rape.	Wiltshires: 2 sides firm, 2 sides showing very slight indications of tenderness. Cumberlands: 2 sides firm, 2 sides soft.
Group V: 8 sides. Same treatment previous to experiment as Group IV. Average weight at beginning of experiment, 94 pounds. Fed six weeks on corn meal.	Wiltshires: 2 sides firm. Cumberlands: 6 sides firm.
Group VI: 6 sides. Same treatment previous to experiment as Group IV. Average weight at beginning of experiment, 107 pounds. Fed six weeks on pease, barley, and shorts.	Wiltshires: 2 sides firm. Cumberlands: 4 sides firm.

[a] Bul. No. 38, p. 17, Central Experimental Farm.
[b] An. Rpt., 1898, Ontario Agricultural College.

Condition of bacon produced by various methods of feeding—Continued.

Description of groups and methods of feeding.	Condition of bacon.
Group A: 24 sides. Purebred hogs, comprising 2 hogs of each of six different breeds. Purchased when from seven to nine weeks old. Kept in pens with small outside yards. Fed wheat middlings until August 19; shorts and barley until September 12; pease, barley, and shorts until October 24.	Wiltshires: 4 sides firm, 2 sides showing indication to tenderness, 2 sides tender, 2 sides soft. Cumberlands: 4 sides firm, 8 sides tender to soft.
Group B: 24 sides. Same as Group A. Same treatment and same meal ration as Group A, but fed whey with meal ration.	Wiltshires: 20 sides firm. Cumberlands: 2 sides firm, 2 sides tender.
Group C: 22 sides. Same as Group A. Hogs were allowed to run in a half-acre lot during whole of experiment. Lot furnished some grass until about the middle of August. Fed the same ration as Group A.	Wiltshires: 10 sides firm, 2 sides very slightly tender. Cumberlands: 2 sides firm, 8 sides tender to soft. Quality of Group C much superior to that of Group A as regards firmness.

In discussing this table, Day calls attention to the condition of the bacon from the first three groups. These were the pigs that had had an abundance of exercise before feeding proper commenced. One lot had corn meal and rape, another corn meal only, and the third a mixed ration of pease, barley, and shorts. Yet the "only tenderness developed in the group fed on pease, barley, and shorts." With the pigs that had had no exercise after weaning (Groups IV, V, and VI) except what they obtained in the pens, the only tenderness in the bacon was in the pigs fed pease, barley, and shorts with rape. The cause of this is not apparent, as the lot on corn meal and rape made firm bacon. The suggestion is made that the lack of exercise may have had this result.

The condition of the bacon from Group B, as compared with Groups C and A, is particularly striking. It is pointed out that, although the pigs of Group B were closely confined, they made firmer bacon than those of Group C, which had an abundance of exercise and very much firmer bacon than those of Group A, which had moderate exercise. The difference is ascribed to the whey fed. The beneficial influence of dairy by-products in bacon production is seen when Groups IV, V, and VI are compared with Group A. These pigs had a ration of grain and skim milk prior to the beginning of the experimental feeding.

The influence of immaturity is seen in the larger proportion of soft sides in the Cumberlands than in the Wiltshires.

Influence of corn on bacon.—The effect of corn feeding in this experiment is decidedly unusual. Generally corn, when fed in large amounts, has produced undesirable bacon. The best results have come from mixed rations, in which barley was prominent. In a later experiment, Day[a] compared the bacon from pigs fed on corn, on

[a] An. Rpt., 1899, p. 81, Ontario Agricultural College.

pease and middlings, on barley, and on barley and rape. The packer reported on them as follows:

Lot I (corn): Very soft, fat, pasty, and greasy, and in every way undesirable. The hogs in this lot seem to have thrived well on the feed, as the sides are well finished, indeed quite fat.

Lot II (pease and middlings): Excellent quality, firm.

Lot III (barley): Very firm, probably the most distinctly hard and firm of any of the lots.

Lot IV (barley and rape): Good quality, firm, with a slight tendency, but very slight, toward tenderness.

The influence of barley on bacon.—Later experiments confirmed the evidence in favor of the use of barley for pigs. In 1900[a] several experiments were conducted with the end in view of comparing the effect of various feeds on the carcass.

In one experiment "the meal ration was as follows: Thirty-one days, 2 parts ground grain to 1 part middlings; forty-one days, 3 parts ground grain to 1 part middlings; remainder of time, or sixty-nine days, ground grain alone. The grain for one group consisted of equal parts of barley and corn, and for the other groups equal parts of barley and oats." The bacon made from these pigs was firm.

In another experiment barley and corn were compared. There were two lots of purebred pigs and they were fed as follows: "Twenty-four days, 1 part grain to 3 parts middlings; thirty-seven days, equal parts grain and middlings; remainder of time, or seventy-nine days, 3 parts grain to 1 of middlings." The bacon from 6 of the 7 hogs on barley and middlings was firm enough for No. 1 selection, 1 pig producing bacon too tender. None of the corn-fed pigs produced bacon firm enough for No. 1 selection.

Influence of roots on bacon.—Three lots of 5 pigs each were fed on meal alone, on meal and raw roots, and on meal and boiled roots. The meal that was fed was ground barley and middlings, and the test lasted one hundred and forty-one days, the meal consisting of 2 parts barley and 1 part middlings at first and changing gradually to clear barley, in the same manner as the pigs in the experiment with barley and corn and barley and oats in the preceding section. The ratio of meal to roots was about 1:1. The roots were discontinued three weeks before shipping the pigs to the packing house. The packer's report showed that all the bacon turned out firm.[a]

In another experiment 11 grade pigs that had been on roots, kitchen refuse, and mixed meal up to a weight of 120 pounds were fed meal and pulped mangels at the rate of 50 pounds of mangels to 22 pounds of meal for sixty-one days. The meal and mangels were mixed the day before feeding. The meal was 2 parts ground barley and 1 part of a mixture of bran and middlings. In this case the roots were fed up to

[a] An. Rpt., 1900, Ontario Agricultural College.

the date of shipping without deleterious results, as all of the bacon cured in firm condition.[a]

In the succeeding year raw pulped mangels were fed in rations of barley and middlings and of corn and middlings in about equal weight to that of meal fed. The feeding records of these experiments have already been reviewed. (See pp. 165–167.)

The following report of the packer shows that roots had no deleterious effect on the bacon:[b]

Barley and middlings: Eight sides, 2 of which were soft, the others grade as No. 1 sides, although there was noticeable in all a very slight tendency to pastiness.

Barley, middlings, and roots: Eight sides, 2 sides soft, 2 sides grading No. 2 (fat). The other 4 sides were very firm.

Corn and middlings: Ten sides; 4 sides tender, i. e., showing softness, but not so soft as to be excluded from No. 1 sides, 2 No. 2. The rest grade as No. 1 sides, although the class as a whole inclines to slight pastiness.

Corn, middlings, and roots: Ten sides, 4 sides soft, 2 grade as No. 2 sides. The balance were very firm.

RESULTS AT OTTAWA.

Grisdale[c] reports experiments at the Central Experimental Farm which were planned to determine the causes of soft pork, and found that the use of mixed rations generally gave the best results. In his first experiment one lot received a mixture of equal parts by measure of ground barley, rye, wheat, and wheat bran; a second, ground wheat, and a third ground buckwheat. All grain was soaked in cold water for an average period of thirty hours. The report of the packers was favorable to the carcasses of the mixed-ration lot, both immediately after cooling and when cured, the wheat-fed lot ranked second and that fed on buckwheat was least desirable. Some sides, however, were soft in the mixed-ration lot and some from the others were firm.

To determine still further the effect of wheat or buckwheat in the ration on the quality of the finished product, one lot was fed a mixture of equal parts by measure of ground barley, rye, wheat, and wheat bran, two on a ration composed of equal parts by weight of this mixture and ground wheat, while the other lot had a similar ration, buckwheat replacing the wheat. All meal was soaked thirty hours in cold water. The buyer and curer reported no difference in the quality of the pork from these lots, from which it would seem that feeding a mixed ration will produce a better quality of bacon than feeding a single grain. This conclusion is also borne out by the results of the feeding of 44 hogs with various rations—single grains, mixtures, with and without milk, dry and soaked, whole and ground. The report of the packer pointed to the value of milk in connection with a single grain, such as corn, and the beneficial effect of a mixture of grains, especially when one of them was barley.

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[a] An. Rpt., 1900, Ontario Agricultural College.

[b] An. Rpt., 1901, Ontario Agricultural College.

[c] *Bul. No. 33, Central* Experimental Farm.

CHEMICAL STUDIES AT OTTAWA.

FIRST SERIES OF EXPERIMENTS.—The following table shows Shutt's[a] averages of results during the first series of tests. The table shows the composition of the ration, the olein content, and the melting point of fat, the averages of these determinations for fat from loin and shoulder being given, as there was found to be very little difference in the characteristics of the fatty tissues from these points in these respects. The rations are arranged from above downward in order of olein content, those showing the least olein in the fat examined being at the top of the table and those showing most olein at the bottom.

It is stated that, as a rule, each pen contained 16 pigs at the start.

Effect of various rations on softness of pork.

[Averages from determinations of first series, 1899. (Shutt.)]

Ration.	Composition of ration.	Olein.	Melting point.
		Per cent.	°C.
F	Oats, pease, and barley, equal parts, soaked, unlimited	67.2	35.6
D	Oats, pease, and barley, equal parts, dry, unlimited	67.5	34.2
B	Corn meal ⅓, oats, pease, and barley equal parts ⅓, dry, unlimited	71.1	34.4
A	Corn meal ⅓, oats, pease, and barley equal parts ⅓, boiled, unlimited	72.7	33.6
B′	Corn meal ⅓, oats, pease, and barley equal parts ⅓, dry, limited	73.1	33.1
M	First period: Oats, pease, and barley, equal parts, soaked Second period: Corn meal, soaked	73.4	32.5
N	Corn meal ⅓, oats, pease, and barley equal parts ⅓, dry, limited	73.7	30.5
K	First period: Oats, pease, and barley equal parts, unlimited Second period: Corn meal, dry, unlimited	74.3	32.4
O	Corn meal ⅓, oats, pease, and barley equal parts ⅓, mangels	74.9	31.7
I	First period: Corn meal ⅓, oats, pease, and barley equal parts ⅓, dry, unlimited. Second period: Corn meal, dry	75.4	32.4
A′	Corn meal ⅓, oats, pease, and barley equal parts ⅓, boiled, limited	75.9	33.6
P	Corn meal ⅓, oats, pease, and barley equal parts ⅓, steamed clover	76.1	32.1
L	First period: Corn meal, soaked Second period: Oats, pease, and barley, equal parts, soaked	76.4	32.3
I′	First period: Corn meal ⅓, oats, pease, and barley equal parts ⅓, dry, limited. Second period: Corn meal, dry, limited	78.1	31.8
H	First period: Corn meal ⅓, oats, pease, and barley equal parts ⅓, boiled, unlimited. Second period: Corn meal, boiled, unlimited	77.9	33.0
J	First period: Corn meal, dry, unlimited Second period: Oats, pease, and barley, equal parts, dry, unlimited	78.8	31.3
H′	First period: Corn meal ⅓, oats, pease, and barley equal parts ⅓, boiled, limited. Second period: Corn meal, boiled, limited	80.0	30.2
G	Beans 1 part, shorts ½ part	84.7	31.0
C	Corn meal, dry, unlimited	92.0	[b]30.9
E	Corn meal, soaked, unlimited	92.4	27.7

[a] Bul. No. 38, p. 15, Central Experimental Farm.

[b] Melting point average on 2 pigs only, as the fat of the others was so soft that the melting point could not be determined.

The effect of feed.—The most striking feature of these results is the good showing of a ration of equal parts of oats, pease, and barley. They were the only ration that produced pork with a sufficiently small amount of olein in the average to rank as "very firm." The carcasses from these pigs were generally firm and even in fat, the fat having a uniform thickness of about 1¼ inches. Growth was continuous and normal. The figures bear out Day's testimony in favor of a ration composed partly of barley, and the general advantage in feeding mixed rations is borne out by these results.

Corn-belt pork producers will be particularly interested in the results of the rations in which corn formed a considerable part. In rations B, A, and B′ it constituted half the grain that was fed, yet the olein content of the fat was 71.1 per cent with ration B and 73.7 per cent in the case of ration B′—not enough to prevent any of the carcasses of these three lots from averaging "firm." When corn meal was fed exclusively during one period of growth, a mixed ration being fed during the remaining time, better results were obtained where it was fed during the closing period than where it was fed during the first period, but the mitigating effect of a mixed ration following corn meal, during the early stages of the pig's growth, may be seen by comparing rations L and J with rations C and E. The olein content of these was 76.4 per cent and 78.8 per cent, respectively, with the former rations, and 92 per cent and 92.4 per cent, respectively, with the latter. However, Shutt[a] says: "Nevertheless, our data show conclusively that when the animal is fed to a weight of 100 pounds on corn exclusively, the corrective action of such an excellent ration as oats, pease, and barley is not sufficient to render the fat firm." He also mentions the oiliness of the fat from the pigs fed corn meal alone during the finishing period, which prevented the bacon from taking rank as first quality, although the fat averaged 3.5 per cent less olein than that from the pigs on corn during the first period.[b] The disadvantage of feeding corn meal exclusively during the entire feeding period, not only because of its effect on the quality of the bacon, but on account of its effect on the growth of the pigs, is very strongly emphasized. The olein content and melting point of the fat from these pigs was the lowest of any of the lots. In addition, it is stated that the pigs made very unsatisfactory growth. Few had reached a weight of 100 pounds at the age of seven months, and some scarcely exceeded that weight at eleven or twelve months; only 5 weighed more than 170 pounds when the experiment closed. The olein content of the fat was greatest in the "finished" pigs, the animals showing marked uniformity in this respect.[c] The packing-house inspection rated as "very soft" twenty-three of the carcasses fed on

[a] Bul. No. 38, p. 24, Central Experimental Farm.
[b] Bul. No. 38, p. 25, Central Experimental Farm.
[c] Idem, p. 19.

corn meal alone, and one as "soft." The meager and uneven covering of fat, its oily character, and the stunted appearance of many of the carcasses was particularly remarked upon. "In many instances the melting point could not be taken, owing to the fluidity of the fat."

The effect of a ration made up largely of beans is somewhat surprising. While the percentage of olein was considerably less and the melting point higher, the feeding value of this ration was quite similar to that of a straight corn ration, the growth being very unsatisfactory and the carcass lightly covered with fat that was very oily.[a]

Shutt calls attention to the rise in the percentage of olein when mangels were fed, but thinks this is "perhaps not to a degree sufficient to warrant any statement as to their effect on the pork." He states further: "Steamed clover, however, appeared to notably increase the olein. Very few of the carcasses from these rations fall into the classes of 'firm' and 'moderately firm,' the influences of the corn (forming half the grain ration) being apparent."

Effect of different conditions of feeding.—As already mentioned, these experiments considered not only the effect of the different feeds given, but the conditions under which they were fed. Those investigated were "the condition of the grain (soaked or dry), the locality or district in which the pigs were littered, and the amount of exercise obtainable." The plan of the experiments to study these conditions was outlined on page 212. The pigs fed rations N, O, and P were eastern Ontario pigs, and hence were not included in the following deductions; neither were the immature animals. The following is quoted:

Boiled as against dry grain.—In the sets of experiments A and B, half corn meal and half oats, pease, and barley, boiled and dry, and I and H, first period, half corn meal and half oats, pease, and barley, boiled and dry, we find that the fat produced from the boiled grain in each case was the softer. In A and B the difference was 2.2 per cent olein, and in I and H the difference was 2.3 per cent olein.

Soaked as against dry grain.—This comparison was made with corn meal (C and E), a mixture of oats, pease, and barley (D and F), with rations employing during the first period corn meal, and second period oats, pease, and barley (J and H), and lastly, first period, oats, pease, and barley; second period, corn meal (K and M). The results are:

Percentages of olein.

	C and E.	D and F.	J and H.	K and M.
Soaked	92.5	67.2	76.4	73.5
Dry	92.1	67.7	78.8	74.4

We scarcely feel justified from these data in drawing any conclusions as to the relative effect on firmness of the same grain ration, fed soaked or dry. A study

[a] Bul. No. 38, p. 22, Central Experimental Farm.

of the individual results does not reveal any definite tendency, and most probably the condition of the grain in this respect has but little, if any, effect on the quality of the pork.

Eastern origin as against western.—This feature was allowed for under all the rations tested.[a] The averages are in the order as discussed.

Percentages of olein.

	A and B.	C and E.	D and F.	I and H.	J and L.	K and M.
Eastern origin	73.4	91.2	67.9	78.6	76.4	74.4
Western origin	73.0	93.4	67.0	77.2	78.9	73.4

In four cases out of six, the olein of the eastern pigs is somewhat the greater, and taken together the averages give a total excess of 3.7 per cent olein over the corresponding western groups. In two cases the western pigs show the larger olein per cent, amounting to 4.7 per cent olein over the corresponding eastern groups. These facts do not warrant us in supposing that there is any marked tendency toward softness in finished pigs due simply to western origin, as is thought by some packers. If finished pigs from the western part of Ontario are softer than those from the eastern, it must be due to the character of the feed they obtain.

Inside as against outside.—As already explained, the pigs denoted as "inside" are held to have had opportunities for limited exercise only—that is, in the small yards attached to the pens of the piggery; the "outside" pigs had the run of an inclosure in which there was a movable sty or shelter for their accommodation at night.

The averages are as follows:

Percentages of olein.

	A and B.	C and E.	D and F.	I and H.	J and L.	K and M.
Inside	71.9	92.3	67.0	77.8	76.5	73.0
Outside	74.5	92.3	67.9	77.9	78.7	74.8

In several of these instances it will be seen the results are practically identical (for differences of less than 1 per cent must not be considered as forming a sufficiently strong basis from which to draw conclusions); in the other cases, the larger amount of olein appears in the fat of the "outside" pigs. There can be no doubt as to the value of a sufficiently large run for young and growing pigs; exercise to a limited extent in the earlier period of an animal's life is essential to a strong and thrifty growth, to good digestion and assimilation of the food.

We therefore do not think it wise, without further evidence, to draw the conclusion that the larger area of exercise had any injurious effects on the quality of the pork. Indeed, a survey of the two seasons' results makes it very clear that the character of the food is the one great influencing factor, and that the varying features or conditions, other than the ration, had very little to do with the relative firmness of the resulting fat.[b]

SECOND SERIES OF EXPERIMENTS.—In 1900 a second series of experiments was begun. All features relating to the effects of maturity

[a] Except rations N, O, and P.—G. M. R.

[b] Bul. No. 38, pp. 26, 27, Central Experimental Farm.

and conditions of feeding were discontinued, because the bad effects of immaturity were regarded as proved, and the effects of conditions, such as boiling and soaking feed, origin, amount of ration and exercise, were regarded as of little importance. Many rations were duplicates of those of the preceding series and, in addition, the influences of skim milk and various succulent feeds were studied from various standpoints, as was also that of a ration of pease alone. As there had previously been found to be no important difference between the olein contents of the fatty tissue from the loin and the shoulder, the samples were taken from the shoulder only in this series of tests.

The following table shows the averages of this series of experiments, arranged in the same manner as the preceding one:

Effect of various rations on softness of pork.

[Averages from determinations of second series, 1900. (Shutt.)]

Ration.	Composition of ration.	Olein.	Melting point.
		Per cent.	°C.
17 C	Corn meal ½, oats, pease, and barley, equal parts ½, skim milk and sugar beets	68.9	32.8
4	Pease	67.2	32.5
17 B	Corn meal ½, oats, pease, and barley, equal parts ½, skim milk and mangels	68.2	32.7
1	Oats, pease, and barley, equal parts	68.7	32.4
17 A	Corn meal ½, oats, pease, and barley, equal parts ½, skim milk and turnips	70.4	32.3
3	Corn meal and skim milk	70.9	32.3
7	Corn meal ½, oats, pease, and barley, equal parts ½, and skim milk	72.3	31.1
13	Corn meal ½, oats, pease, and barley, equal parts ½; from October 16, ½ corn meal, ½ pease	72.3	31.3
12	Corn meal ½, oats, pease, and barley, equal parts ½, and cooked pumpkins	73.3	31.4
14	Corn meal ½, oats, pease, barley ½, and artichokes	73.4	31.5
9	First period: Oats, pease, and barley, equal parts. Second period: Corn meal	73.9	31.1
11	First period: Pastured on rape; corn meal ½, oats, pease, and barley, equal parts ½. Second period: Raw pumpkins and same grain	74.2	31.6
6	Corn meal ½, oats, pease, and barley, equal parts ½	74.6	30.3
10	Pastured first on rape, finally on artichokes; corn meal ½, oats, pease, and barley, equal parts ½	74.9	31.4
16	First period: Corn meal. Second period: Oats, pease, and barley, equal parts	76.1	30.9
15	Pastured on clover; from October 30, fed clover; corn meal ½, oats, pease, and barley, equal parts ½	76.1	30.3
8	First period: Corn meal ½, oats, pease, and barley, equal parts ½. Second period: Corn meal	77.9	30.3
2	Corn meal only	83.6	28.6
5	Beans	84.9	28.5

The remarkable feature of these results is the good showing made by a ration in which skim milk formed a considerable part. Although corn meal made up half the amount of grain fed, the addition of

skim milk and sugar beets gave this ration the firmest pork in the experiment. Rations A and B in the first series, which were the same without milk and roots, gave an average olein content of 73.2 per cent, which would grade the bacon as "soft," whereas the bacon from ration 17 C gave an olein content of only 66.9 per cent, grading "very firm." Shutt[a] is evidently not prepared to attribute a great amount of this difference to the use of succulent feeds, but rather regards the presence of roots as not detrimental. As ration 17 B in the second series and ration O in the first were identical, and as there was a difference of 6.7 per cent in olein content in favor of the skim milk ration, there are good grounds for attributing the greater influence to skim milk. The most remarkable corrective influence of this dairy by-product is seen when ration 3 (corn meal and skim milk) is compared with ration 2 (corn meal only). The advantage in olein content is 12.7 per cent in favor of the skim milk. Comparing rations 7 and 6, the corrective influence of skim milk when fed in a mixed grain ration is seen to be less than when corn meal alone makes up the grain of the ration. This result is similar to those obtained when studying the rate and economy of gain from various rations, and it would seem to indicate that variety in the ration is important as regards the firmness of the pork produced. These results show the same advantages in favor of feeding corn meal during the finishing period and mixed grain in the earlier stages, rather than feeding corn meal during the earlier months of life. (Compare rations 9 and 16.)

From the showing of the lots on roots, etc., Shutt[b] concludes that "rape, pumpkins, artichokes, sugar beets, turnips, and mangels can be fed in conjunction with a good ration without injuring the quality of the pork." With clover, however, he found a higher olein content than where no clover was fed, the percentage of olein being 76.1 in the first instance and 74.6 in the latter. (Compare rations 6 and 15.) He regards the fact that 76.1 per cent was the olein content of the pigs on ration P in the first series, which contained steamed clover, as emphasizing this opinion. The pigs on succulent feed showed a tendency to become too fat, particularly in the case of ration 10, where they had rape and artichokes.

A ration of equal parts of oats, pease, and barley proved very valuable, as in the first series; pease alone proved to have a very high feeding value, which was contrary to Day's experience but in line with that of the Wisconsin results. However, Day has found pease to produce a firm quality of bacon, but objects to them as a single feed for pigs, as his results do not show good gains with them alone. Beans again proved to be undesirable when fed without corrective feeds.

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[a] Bul. No. 38, p. 30, Central Experimental Farm.

[b] Bul. No. 38, p. 36, Central Experimental Farm.

FEEDING TO HARDEN THE FAT OF PORK.

A rather anomalous state of affairs exists in the fact that while authorities in Canada counsel feeders to refrain from very extensive use of corn in pig feeding, farmers in the South generally feed corn to harden the pork, and the investigations of the experiment stations seem to bear out this practice. It is said that when pigs are grazed on such feeds as chufas, peanuts, or other oily feeds, the pork made is extremely soft and oily and the lard more or less liquid. To counteract this, corn is fed during the latter part of the feeding period or as a large part of the ration during the entire time the pigs are on feed. Recently the effect of cotton-seed meal on the fat has been investigated with good results so far as increased firmness is concerned.

Effect of corn.—According to Bennett,[a] if good grade or purebred pigs are grazed on peanuts or chufas, either alone or combined, and if at the same time they are fed an amount of corn sufficient to full feed exclusively for four weeks, the quality of the pork and lard produced can not be distinguished in appearance from that of pigs fed on corn exclusively. Bennett[a] regards the use of more than this amount of corn as too expensive for the results obtained. He also reports that his results have shown that purebred pigs or good grades produce a firmer quality of pork and lard than scrubs. The range of individual variation in the melting point of lard from scrubs was much larger than that of the lard from grades and purebreds. Duggar,[b] however, states that in his experience, even when fed a month exclusively on corn, pigs formerly on peanuts made much more oily and soft pork and lard than hogs fed corn throughout the entire feeding period. This condition was noticeable even after cooking. "One month of exclusive corn feeding increased the firmness of pork made from animals previously fed on peanuts alone, but the improvement was not sufficient to make the flesh or the lard as firm as the same articles afforded by animals fed entirely on corn." Both Bennett and Duggar state that while exclusive peanut feeding injures the sale of lard and pork by making it soft and oily the cooking quality does not seem to be impaired.

As parts of the grazing experiments already noted Bennett determined the effect of the feeds on the melting point of the lard. The following table shows the averages of his results for three years. Regarding the determination of the melting point Bennett[c] says: "The figures reported for each pig (back and kidney) are the averages of four determinations of each sample of lard previously rendered from samples of fat. The back fat was taken from one side of each pig, in a strip extending from a point over the kidneys to the thin edge of the side."

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[a] Bul. No. 65, Arkansas Expt. Sta.
[b] Bul. No. 93, Alabama Expt. Sta.
[c] Bul. No. 65, p. 103, Arkansas Expt. Sta.

Average melting point of lard from pigs on different feed.

Year.	Feed.	Number of pigs.	Average melting point.			
			Back.		Kidney.	
			°C.	°F.	°C.	°F.
1898	Grazed on peanuts, chufas, and soy beans without corn	7			37.0	98.6
	Grazed as above, followed by corn feeding ten days	4			34.2	93.6
	Fed corn exclusively	3			43.8	110.8
1899	Grazed on peanuts and chufas without corn to harden the lard	10	22.9	73.2	31.2	88.2
	Grazed as above, with corn to harden the lard	6	26.3	79.3	34.1	93.4
1900	Grazed on peanuts and chufas with corn	12	33.1	91.6	38.4	101.1
	Grazed as above, followed by corn feeding	8	32.5	90.5	37.8	100.0

Duggar[a] reports similar tests from the pigs in the Alabama experiments already mentioned. The melting points of lard from pigs fed in various ways were as follows:

Effect of corn on melting point of lard.

Ration.	Number of pigs.	Kind of lard.	Melting point of lard.	
			°F.	°C.
Corn	2	Leaf and body lard	111.2	44.0
Peanuts ½, corn ½	1	do	104.1	40.5
Peanuts	1	do	76.1	24.5

The following table shows the results of a test Duggar[b] conducted to determine the effects of feeding on corn alone after peanut feeding. The hogs had corn exclusively for one month before slaughtering:

Effect of corn on melting point of lard.

Ration previous to one month before butchering.	Melting point of lard.	
	°F.	°C.
Peanuts ½, corn ½	98.6	37.0
Peanuts	101.3	38.5

By comparing these figures with those immediately preceding, the effect of the corn feeding on the lot formerly on peanuts is apparent, but exclusive corn feeding had no appreciable effect on hogs that had formerly been on a ration consisting in part of corn. Bennett reached the same results at Arkansas. In his experiment of 1900

[a] Bul. No. 93, Alabama Expt. Sta. [b] Idem.

there is very little difference in melting point between hogs fed corn while grazing peanuts and those having corn after grazing.

The effect of cowpeas and corn.—Duggar[a] has reported a number of additional experiments to study the hardening effect of various methods of feeding and different rations. Where a pig that was fed a ration of one-third ground cowpeas and two-thirds corn meal was compared with pigs which had grazed sorghum, peanuts, or chufas, with and without grain, the melting point of the fat of the jowl was determined as follows:

Effect of cowpeas and corn on the firmness of lard.

Feed during 28 days before butchering.	Feed prior to 28 days before butchering.	Melting point of fat.	
		°C.	°F.
Cowpea meal ⅓, corn meal ⅔; peanuts...	Cowpea meal ⅓, corn ⅔; grazed sorghum.	28.0	82.4
Peanuts alone	Peanuts; grazed sorghum	22.0	71.6
Cowpea meal ⅓, corn meal ⅔; chufas.....	Grazed cowpeas	27.5	81.5
Cowpea meal ⅓, corn meal ⅔	Cowpea meal ⅓, corn ⅔	20.0	68.0

The softening effect of an exclusive peanut ration and the hardening effect of the ration of ground cowpeas and corn are manifest from the above table.

The effect of cotton-seed meal.—Pigs which had received the same previous treatment as the last three lots in the foregoing table were placed on a ration of cotton-seed meal one-fourth, corn meal three-fourths, for thirty-five days.[a] The melting point of the body fat was determined as follows:

Effect of cotton-seed meal on the firmness of lard.

Feed during 35 days before butchering.	Feed second month before butchering.	Melting point of fat.
		°F.
Cotton-seed meal ⅓, corn meal ⅔	Peanuts alone	87.4
Cotton-seed meal ⅓, corn meal ⅔	Cowpea meal ⅓, corn meal ⅔, chufas, etc.	82.4
Cotton-seed meal ⅓, corn meal ⅔	Cowpea meal ⅓, corn meal ⅔[a]	84.9

[a] Full grain ration.

By comparing the above table with that which precedes it, it will be seen that where pigs had been grazing peanuts or chufas before being fed the cotton-seed-meal ration there was a marked effect on the firmness of the fat, but where they had been on a ration of cowpea meal one-third and corn meal two-thirds there was little or no effect.

[a] Bul. No. 122, Alabama Expt. Sta.

Another test[a] of a similar nature showed melting points of the body fat, as follows:

Effect of various feeds on the firmness of lard.

Number of pigs.[a]	Feed during 35 days before butchering.	Feed prior to 35 days before butchering.	Average melting point of body fat.
			° F.
2	Cotton-seed meal ½, corn meal ½	Peanuts	84.0
1	Corn meal	Peanuts	80.7
1	Corn meal (Essex pig)	Corn, grass pasture	86.0
2	Chufas	Peanuts	74.9
2	Peanuts	Peanuts	74.6

[a] Excepting the Essex pig, these were from the same litter.

These results show the softening effect of either peanuts or chufas and seem to give further evidence that a ration of cotton-seed meal and corn meal has an influence on the firmness of fat greater than that of a ration of corn alone. Duggar points out that these results do not show as firm fat as previous tests at the Alabama Station.

Another test gave still more evidence in favor of a cotton-seed meal ration, the results being as follows:[a]

Effect of cotton-seed meal on the firmness of lard.

Feed during 35 days before butchering.	Melting point of fat.	
	Kidneys.	Jowl.
	° F.	° F.
Cotton-seed meal ½, corn meal ½ (half ration); grazed sorghum	115.2	87.4
Cotton-seed meal ½, corn meal ½ (half ration); sorghum fed	115.2	85.3
Cotton-seed meal ½, corn meal ½ (half ration); grazed peanuts	99.7	80.6

The effect of cotton-seed meal, corn meal, and rice polish.—A test with these feeds following grain rations and feeding on pasture showed the following results:[a]

Effect of various feeds on the firmness of lard.

Number of pigs.	Feed during 31 days before butchering.	Feed from fifty-fifth to thirty-second day before butchering.	Average melting point of body fat.
			° F.
2	Cotton-seed meal ½, corn meal ½	Corn meal; peanuts	81.4
2	Corn meal	Corn meal; peanuts	78.0
1	Corn meal[b]	Grain ration	85.1
1	Corn meal; skim milk[c]	Corn meal; peanuts[d]	76.1
1	Rice polish[b]	Corn meal; peanuts[d]	74.2
1	Rice polish[b]	Grain ration	78.3

[a] Bul. No. 122. Alabama Expt. Sta.
[b] Fifty-six days.
[c] Milk for only nineteen days, and then in small amounts.
[d] Twenty-three days.

These results give still more evidence in favor of the use of a cotton-seed-meal ration to harden the fat. The body fat of the pigs fed in this manner was considerably firmer than that of those fed on corn meal.

Rice polish did not give so favorable results as corn meal.

Firmness of lard from immature pigs.—Young pigs, averaging about 60 pounds in weight at the middle of the experiment of thirty-seven days' feeding, were fed various rations and the melting point of the fat from the jowl and around the kidneys determined. The results were as follows:

Effect of immaturity on the firmness of lard.

Number of pigs.	Feed during 37 days before butchering.	Feed during preceding period of 42 days.	Average melting point of fat.	
			Kidneys.	Jowl.
			° F.	° F.
2[a]	Cotton-seed meal ½, corn meal ½	Grazed Spanish peanuts	88.7	67.4
2	Cowpea meal ½, corn meal ½	Grazed Spanish peanuts	88.7	72.3
2	Corn meal	Grazed Spanish peanuts	88.7	75.6
1[b]	Peanuts alone	Grazed Spanish peanuts	89.6	68.2

[a] One of the pigs in this lot died from the effects of cotton-seed-meal poisoning.
[b] This pig was butchered at the close of the forty-two days on peanuts.

These results agree with those of the Canadian experiments, that the fat of young and immature pigs is softer than that of mature ones. Duggar regards the low melting point of the fat of the pigs on cotton-seed meal in this test as due to accidental or unusual causes and therefore not of great value.

CHEMICAL COMPOSITION OF CARCASSES OF PIGS.

At the close of the Iowa experiment of 1897 one carcass from each lot, including the lots fed wide and narrow rations, was sent to Washington for analysis by the Division (now Bureau) of Chemistry[a] of the Department of Agriculture. The heads, leaf lard, and viscera were not included in the shipment, and no data are available on these parts. When the analyses were made no information was given as to the identity of the wide and narrow ration carcasses. Duroc Jersey No. 5 was from the lot fed the narrow ration, and No. 6 from those fed the wide ration.[b] In the discussion of the results these facts are considered, the tables being studied for the results with the several breeds, and then to compare the results of the two rations. The following table shows the proportions of the various parts of the carcasses:

[a] Bul. No. 53, Div. Chemistry, U. S. D. A.
[b] Bul. No. 48, p. 408, Iowa Expt. Sta.

Relative proportions of the dressed animal, the head, leaf lard, and kidneys having been removed.

Serial number and breed of pig.	Weight (Washington).	Percentages of parts.							
		Meat (fat and lean).	Bones, less marrow.	Marrow.	Skin.	Spinal cord.	Tendons.	Hoofs.	Total.
	Pounds.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
1. Berkshire	129.6	88.19	7.44	0.12	3.80	0.09	0.27	0.09	100
2. Tamworth	141.0	86.50	8.18	.21	4.71	.09	.21	.10	100
3. Chester White	125.8	87.94	6.21	.08	5.52	.07	.12	.06	100
4. Poland China	146.4	90.67	5.30	.11	3.63	.08	.14	.07	100
5. Duroc Jersey (narrow ration)	137.6	88.03	5.92	.11	5.75	.04	.10	.05	100
6. Duroc Jersey (wide ration)	167.1	90.93	4.70	.10	4.00	.07	.12	.08	100
7. Duroc Jersey	149.2	89.90	5.07	.11	4.65	.08	.11	.08	100
8. Yorkshire	160.3	86.79	7.41	.13	5.30	.09	.18	.10	100
Means	144.6	88.62	6.28	.12	4.67	.08	.16	.08	100
Maxima	167.1	90.93	8.18	.21	5.75	.09	.27	.10	100
Minima	125.8	86.50	4.70	.08	3.63	.04	.10	.05	100

Considering the carcasses that were in the breed test proper, the Yorkshire carcass is found to be very much the heaviest and the Chester White the lightest.

In relative weight of meat there is not a great amount of variation, the Poland China having the greatest weight, 90.67 per cent, and the Tamworth the least, 86.50 per cent. In relative weight of bones, less marrow, there is a range from 5.07 per cent in the Duroc Jersey to 8.18 in the Tamworth. The marrow varies from 0.08 per cent in the Chester White to 0.21 per cent in the Tamworth carcass. The skin shows a minimum of 3.63 per cent in the Poland China and a maximum of 5.52 per cent in the Chester White carcass. The weight of the spinal cord is 0.09 per cent in the Berkshire, Tamworth, and Yorkshire, and 0.07 in the Chester White. In weight of tendons, the Berkshire shows the highest percentage, 0.27, the Duroc Jersey the lowest, 0.1 per cent. In hoofs, the Tamworth and Yorkshire carcasses together were heaviest, with 0.1 per cent of the live weight, and the Chester White least, with 0.06 per cent.

It is difficult to notice any effect that may have been due to the feed which Duroc Jersey No. 5 (narrow ration) and Duroc Jersey No. 6 (wide ration) received. It will be recalled that the nutritive ratio of the narrow ration was 1:4.1, and that of the wide ration 1:7.8. There is a difference in favor of the wide-ration lot of nearly 3 per cent in weight of meat, of 1.22 per cent in weight of bones, and of 1.75 per cent in weight of skins in favor of the narrow ration. The weight of marrow is 0.11 per cent of the dressed weight in the nar-

row-ration carcass and 0.1 per cent in the wide ration. The weight of spinal cord is 0.04 per cent and 0.07 per cent of the narrow and wide rations, respectively, this amount for the narrow ration being the least in the table. The percentages of tendons are 0.1 and 0.12, respectively, for the narrow and wide rations, and of hoofs 0.05 per cent and 0.08 per cent, respectively. In a number of particulars the maxima or minima of the table were found for one of these carcasses, which will explain seeming inaccuracies in the preceding paragraph.

The following table shows analytical data for the carcasses examined:

Analytical data of the dressed animal, the head, leaf lard, and kidneys having been removed.

Serial number and breed of pig.	Weight.	Water.	Fat.	Nitrogenous substances.				Lecithin.	Ash.	Total.
				Proteids insoluble in hot water.	Gelatinoids.	Flesh bases.	Total.			
	Pounds.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
1. Berkshire	129½	43.10	40.46	10.45	0.89	1.16	12.02	0.27	2.87	98.62
2. Tamworth	141	41.09	42.97	9.65	1.15	1.14	11.99	.17	2.68	98.85
3. Chester White	125½	35.80	51.11	7.89	.92	1.50	9.85	.17	1.84	98.77
4. Poland China	146½	37.89	48.90	7.27	1.11	1.21	9.66	.19	1.83	98.41
5. Duroc Jersey (narrow ration)	137½	32.89	55.07	6.55	1.24	1.14	8.99	.11	2.01	98.39
6. Duroc Jersey (wide ration)	167 1/10	30.31	58.81	7.73	.92	1.11	9.80	.19	1.75	98.85
7. Duroc Jersey	149½	30.58	57.68	7.08	1.10	.78	8.96	.42	1.81	99.45
8. Yorkshire	160 2/5	40.39	44.35	8.89	1.42	1.08	11.44	.31	2.40	98.89
Means	144½	36.43	49.67	8.12	1.10	1.14	10.46	.23	2.11	98.91
Maxima	167 1/10	43.10	57.68	10.45	1.42	1.50	13.02	.42	2.63	99.45
Minima	125½	30.31	40.46	6.55	.89	.78	8.96	.11	1.75	98.41

In this table the nitrogenous substances "are divided into three classes, namely, the true proteids insoluble in hot water; gelatinoids, which are of a true proteid character, but soluble in hot water, and of which gelatin is the type; and the flesh bases which are soluble in hot water and are not precipitated by the action of bromin."[a]

Lecithin was determined by extraction with a mixture of alcohol and ether and the determination of the phosphorus in the extract. As some of the lecithin is removed when the fat is extracted with ether, the determination of lecithin in the fleshy residue of the meat after fat extraction did not represent all the lecithin which was in the meat. On the other hand, in the case of marrow and spinal cord, a great proportion of these substances is fat, and for this reason and the additional one that there was a very small amount of material available for analysis, the lecithin in the fat extracted was deter-

[a] Bul. No. 53, p. 66, Div. Chem., U. S. D. A.

mined as the amount in the original sample. For these reasons it is pointed out that the figures for lecithin represent less rather than more of the actual amounts in the original samples. Wiley, under whose direction the analyses were made, regards lecithin as very important physiologically.

In studying this table it is useless to attempt any differentiation to show the influence of the rations fed, for it is at once apparent that in the case of the narrow ration carcass (Duroc Jersey No. 5), the breed influence predominated, because, in spite of the fact that this carcass was fattened by the use of a nitrogenous ration, it will be seen that the analyses agree closely with those of the Duroc carcass in the breed test and the one on the wide ration.[a]

It is seen that the amounts of water and fat in these analyses bear an almost constant relation to each other—a minimum quantity of fat being found with a maximum quantity of water. For example, the greatest amount of water is shown in the Berkshire carcass, which also has the least amount of fat. The Duroc Jersey carcasses show a slight variation, in that carcass No. 6 (wide ration) is least in water content, with 30.31 per cent, but seventh in fat content, with 56.81 per cent. The greatest amount of fat was found in the carcass from the breed test No. 7, with 57.68 per cent. It is significant that the three Duroc Jersey carcasses are least in water content and greatest in fat content. The proportion of total nitrogen shows a tendency to vary with the amount of fat present, and does so in the case of the Berkshire, Tamworth, and Yorkshire carcasses. In proteids insoluble in hot water the Berkshire, Tamworth, and Yorkshire carcasses lead in the order named, which is the only feature of note in this column. If we consider the results for proteids insoluble in hot water, there does not seem to be any variation in gelatinoids and flesh bases that may be ascribed to breed influence; in fact, with a few exceptions, there is little variation from the mean.

The greatest percentage of lecithin (0.42) is seen in the Duroc carcass No. 7, and the least (0.11) in Duroc No. 5 (narrow ration).

The wide-ration Duroc shows .19 per cent lecithin—somewhat below the mean; the Tamworth, Berkshire, and Yorkshire, which had the greatest weight of bones, stand in the same relative order in ash content. The same tendency appears with the other carcasses, Duroc No. 7 (breed test) and Duroc No. 6 (wide ration) being seventh and eighth both in weight of bones and ash content.

Water content of fat of pigs fed various rations.—At the close of the Wisconsin experiment which compared a ration of pea meal, middlings, and skim milk with one of corn meal and skim milk, the fat

[a] The reader should recall, however, that the narrow ration was not very different in nutritive ratio from the one used in the breed test, the one being 1:4.1; the other, 1:5.6.

of the kidney and loin of 2 pigs in each lot was analyzed to determine the water content, with the following results:

Water content of fat of pigs. (Woll.)[a]

Feed and breed.	Kidney fat.	Loin fat.
Corn meal and skim milk:	*Per cent.*	*Per cent.*
Poland China	2.6	3.82
Yorkshire	3.15	4.85
Average	2.87	4.18
Ground peas, middlings, and skim milk:		
Poland China	3.27	7.62
Yorkshire	3.71	5.68
Average	5.99	6.65

[a] Seventeenth An. Rpt., Wisconsin Expt. Sta.

The fat from pigs on the narrow ration contained considerably less water than that from the pigs on the wide one. Carlyle and Hopkins[a] remark that they are not prepared to state what effect the larger percentage of water in the fat from the narrow-ration pigs would have "on the curing and edible qualities of the meat," but the smaller amount of water in the kidney fat of the corn-fed pigs would certainly add to its value "over the other for lard-rendering purposes."

SUCKLING PIGS ON A SKIM-MILK DIET.

Experiments with suckling pigs on a diet of separated cow's milk alone and milk to which lactose or dextrose had been added, have recently been reported by Miss Margaret B. Wilson.[b] Preliminary to the report on her work, she presents the results of similar studies by Sanford and Lusk at the Yale Medical School. In these latter experiments 1 pig was fed a ration of skim milk plus 2 per cent of milk sugar (lactose), a second a ration of skim milk plus 3 per cent dextrose, and the third skim milk only. A new-born pig from the same litter was killed and analyzed in order to determine the growth in proteid substances, the amount in the new-born pig being taken as that of the others, and the difference between the estimated amount at birth and the amount found by analysis at the close of the feeding was attributed to growth. The pigs were fed fourteen days.

Miss Wilson conducted her studies along similar lines, and throughout compared her results with those obtained by Camerer, Rubner, Oppenheimer, and others in studying the nutrition of growing infants.

Six new-born pigs from the same litter were obtained. Three of them were at once submitted to analysis, and 3 were reared on skim milk. Of these 3 the skim-

[a] Seventeenth An. Rpt., p. 22, Wisconsin Expt. Sta.

[b] Amer. Jour. Physiology, VIII, 3.

milk pig was fed on skim milk alone; the lactose pig received the same skim milk to which 3 per cent of lactose had been added; and the third pig, the dextrose pig, was nourished with the same skim milk containing 3 per cent of added dextrose. After sixteen days the pigs were killed and submitted to analysis.

The following table is presented to show some of the results relating to growth in both series of experiments:

Growth of suckling pigs.

	Wilson.			Sanford and Lusk.		
	Skim milk.	Lactose.	Dextrose.	Skim milk.	Lactose.	Dextrose.
Weight when born ....grams..	1,322.0	1,295.0	1,485.0	1,000.0	1,050.0	1,152.0
Weight when killed ....do...	2,205.0	2,435.0	2,471.0	1,246.0	1,890.0	2,000.0
Growth ....do...	883.0	1,140.0	986.0	264.0	838.0	848.0
Growth ....per cent..	66.8	88.0	66.4	26.4	79.7	73.6
Milk fed ....c.c..	10,925.0	11,005.0	9,707.0	6,826.0	8,836.0	9,481.0
Available calories fed	4,053.0	5,216.0	4,620.0	2,339.0	3,736.0	3,972.0
Growth per liter of milk..grams..	81.0	114.0	101.0	38.0	95.0	89.0
Growth per 1,000 calories fed .do...	218.0	215.0	213.0	114.0	222.0	213.0

Miss Wilson calls attention to the fact that, with the exception of the skim-milk pig in Sanford and Lusk's experiment, which was a poorly nourished pig that did not do well at any time, the growth of all these pigs was "directly proportioned to the calorific value of the food to the organism." She notes that Oppenheimer has obtained similar results with normal breast-fed children of the same age.

Further details relating to the growth of the pigs were ascertained. The analyses of the 3 new-born pigs were as follows:

	Grams.	Per cent.
Live weight (aggregate)	3,247.0	.....
Dry solids	637.4	19.7
Fat	47.56	1.15
Proteid	390.5	12.0
CaO (average of 2 pigs)	.....	1.88

From these results data regarding the growth of the other pigs were obtained as follows:

Growth of suckling pigs. (Wilson.)

Ration.	Estimated composition at beginning.				Growth.			
	Solids.	Fat.	Proteid.	CaO.	Solids.	Fat.	Proteid.	CaO.
	Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Skim milk	260.4	15.20	158.90	24.85	175.8	13.18	162.4	11.32
Lactose	255.1	14.89	155.66	24.35	240.5	20.01	204.3	15.42
Dextrose	292.5	17.08	178.50	27.92	202.7	16.16	170.6	12.35

From these figures, and those relating to the feed eaten, Miss Wilson compiled the following table to show the relation between the amount of growth and consumption of feed:

Relation between feed consumed and growth.

Ration.	Feed.			Growth.			Feed used for growth.		
	Proteid.	Fat.	CaO.	Proteid.	Fat.	CaO.	Proteid.	Fat.	CaO.
	Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Per ct.*	*Per ct.*	*Per ct.*
Skim milk	455.6	15.29	21.74	162.4	13.18	11.32	35.6	86	52
Lactose	458.9	15.40	21.90	204.3	20.01	15.42	44.5	130	70
Dextrose	404.8	13.59	19.32	170.6	16.16	12.35	42.1	111	64

In Sanford and Lusk's experiments, reported by Miss Wilson,[a] the amount of proteid substances used to build up new tissue was 23 per cent for the pig on skim milk only, 38 per cent for the one on lactose, and 48 per cent for the one on dextrose. According to Miss Wilson, W. Camerer, jr.,[b] found 40 per cent proteid of the food retained for growth by a nine-weeks-old nursing infant. The results in the table show 35.6 per cent proteid retained for growth by the pig on skim milk, 44.5 per cent by the pig on lactose, and 42.1 per cent by the pig on dextrose. These results agree closely with the work quoted, especially when it is remembered that the skim-milk pig in Sanford and Lusk's experiment was not thrifty.

The relative amount of fat of growth compared to that in the food is 86 per cent with the skim-milk pig, 130 per cent with the lactose pig, and 111 per cent with the dextrose pig. This large increase is attributed to two factors—a possible error in the estimation of fat in the food and the conversion of milk sugar into fat. As the fat was "almost completely assimilated," these results show "that the carbohydrates fed were amply sufficient to furnish the needed energy, while a normal growth of tissue was progressing. No fat combustion was necesary for the life processes."

The calcium used for growth was 52 per cent of that in the food consumed by the skim-milk pig, 70 per cent of that consumed by the lactose pig, and 64 per cent of that consumed by the dextrose pig. As the dry solids of the 3 pigs contained, respectively, 8.29, 8.02, and 8.13 per cent of calcium, it is held that "the calcium addition depended rather upon the development of the organism than upon any specific influence of the milk constituents." Miss Wilson's results show an average of 9.40 per cent of calcium in the new-born pig and an average of 8.15 per cent at the age of sixteen days.

The energy stored in the animals during growth was estimated to be 772 calories in the skim-milk pig, of which 16 per cent was in the fat deposited; 1,002 calories in the lactose pig, of which 18.6 per cent

[a] Amer. Jour. Physiology, VIII, 3, p. 200. [b] Loc. cit., p. 207.

was in the fat; and 832 calories in the dextrose pig, of which 18 per cent was in the fat. The following table shows facts relating to energy:

Energy liberated in growing pigs. (Wilson.)

Energy—	Skimmed milk.	Lactose.	Dextose.
	Calories.	*Calories.*	*Calories.*
In the food	4,053	5,216	4,620
Stored in the body	772	1,002	832
Liberated as heat	3,281	4,214	3,788
Fed daily per square meter of surface	2,008	2,404	2,087
Liberated as heat daily per square meter of surface	1,618	2,005	1,600
Retained per 1,000 calories in the feed	191	192	180

According to Miss Wilson, "the human infant requires daily in the food about 1,200 calories per square meter of surface, while a more active older child requires 1,500." All of the pigs required over 2,000 calories per square meter of surface, and that of the lactose pig 2,400; this "corresponds to that needed by a man at hard labor." The large requirement is explained by the active, bustling life of the young pigs, which was "to a very large degree a life of hard work." Attention is called to the fact that not only did the pigs gain in weight in proportion to the number of calories in the food, but the energy stored in the body was also in proportion to the number of calories in the food.

Miss Wilson concludes that "a large and apparently normal growth" may be attained by the use of skim milk, and that the addition of sugars has a good effect, adding calorific power to the milk. She regards it as unessential whether fuel value is added to skim milk by fat, milk sugar, or dextrose, provided there is a sufficient amount of proteid in the milk; sucklings will grow well under any of these circumstances. This conclusion emphasizes the importance of the experiments by Wilson and Curtiss[a] at the Iowa Experiment Station, who found that corn meal could supply the place of fat in skim milk when fed to calves. The summary of these experiments is inserted entire as follows:

(1) Skimmed cow's milk, with or without 2 to 3 per cent of added lactose or dextrose, is normally absorbed by suckling pigs.

(2) Two pigs fed on skim milk from fourteen to sixteen days gained 26.4 and 66.8 per cent in weight. Two pigs fed on skim milk, with 2 and 3 per cent of lactose added, gained 79.7 and 88 per cent in weight. Two pigs fed on skim milk, with 2 and 3 per cent of dextrose added, gained 73.6 and 64.4 per cent in weight.

(3) Those fed with plain skim milk gained 114 and 218 grams in weight for every 1,000 physiologically available calories in the food. The lactose pigs gained 222 and 215 grams per 1,000 calories in the food. The dextrose pigs both gained 213 grams per 1,000 calories in the food. Except in the case of one ill-nourished skim-milk pig the growths of the sucklings stand in a constant ratio to the calories in the food.

[a] Buls. Nos. 19, 25, and 35. The calves fed were considerably older than the pigs in the experiments at New Haven.

(4) The pigs fed on plain skim milk used 23 and 35 per cent of the protein in the food for tissue growth, the lactose pigs used 38 and 44 per cent, and the dextrose pigs 48 and 42 per cent.

(5) All the pigs of the second litter gained in fat when fed on plain skim milk or on skim milk with sugars.

(6) The percentage of calcium in the bodies of the pigs diminished with their growth. There was considerable and normal deposition of calcium in the pig, and this was proportional, not to the calcium in the food, but to the growth of the animal.

(7) Not only is the growth in grams of the pigs proportional to the calories in the food, but the number of calories retained in the tissue substance during growth is proportional to the calories in the food. From 18 to 19 per cent of the calories in the food were found stored in the tissue growth of the pigs fed on the three varieties of skim milk.

(8) There seems to be striking evidence that the suckling pig reared on skim cow's milk conforms to the same laws of nutrition as the breast-fed infant.

MISCELLANEOUS EXPERIMENTS AND INFORMATION.

ACORNS.

Carver[a] has shown that acorns compare rather favorably with corn in chemical constituents. Hogs fattened on them yield rather soft, spongy flesh, with an oily lard that hardens with difficulty. This, it is suggested, might be overcome by feeding corn a few weeks before marketing. Districts in Alabama are mentioned where cattle and hogs live entirely on acorns and the pipe-stem cane.

EXPERIMENTAL PORK ON THE ENGLISH MARKET.

After each slaughtering of the Iowa pigs (see pp. 179–180) a Chicago firm shipped some of the pork to their agents at Liverpool, for sale on the English market. Very complete reports were received regarding the suitability of these cuts abroad.

In 1897 the opinion of the packers, before the above shipment was made, was that the Berkshire and Tamworth pigs were "the most suitable for the making of English meats."[b] The lots of pork that were unsuitable on account of feeding were one of long cut hams from Poland China pigs and one of long-cut hams from Chester White pigs which were "too fat and short." One lot of American-cut hams from the Berkshires was rendered unsuitable for the English market by cutting. Some of the cuts were criticised as soft and spongy, others as somewhat fat, but they were not necessarily condemned on account of fat. A tendency in the Yorkshire long-cut hams to be "rather stout" was remarked upon.

In 1898 a still more complete report was received concerning the cuts that were shipped to England. The cuts from the Tamworths

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[a] Bul. No. 1, Alabama, Tuskegee Inst. [b] Bul. No. 48, p. 391, Iowa Expt. Sta.

were all reported suitable for the English trade, although some were criticised as being somewhat too fat. The Berkshire cuts were given second place, only two being condemned as being too fat for the British market. The showing of the Yorkshire cuts in this shipment was surprising. Out of eight Cumberlands cut from Yorkshire pigs only one was suitable for export, the others being "much too fat." Out of eight Yorkshire short-cut hams four were condemned on account of fat. The Yorkshire cuts were the least suitable of the shipment.

This characteristic of the Yorkshires in this experiment brings up the very important question regarding the influence of feed on the carcass. It also shows how individual and family characteristics are strong factors in experimental work. In justice to the breed it should be said that it is highly valued for its high-class pork products and is employed in every country where the production of prime bacon is a feature of pig feeding. The breed is more extensively used than any other in Denmark, where the finest bacon of international trade is produced. Yet in the Iowa tests it was said that the Yorkshires were deficient, "as the thickness of fat on the back was much greater than the trade desired."[a] The suitability of the Yorkshires for the export bacon trade is shown in the résumé on the Ontario Agricultural College work in the following paragraph:

Summarizing the results of five years of work with six breeds at Guelph, Day would rank the Yorkshire first in suitability for the export trade, placing the Tamworth second and the Berkshire third. The showing of the other breeds that were fed (Chester-White, Duroc Jersey, and Poland China) was so unsatisfactory in the production of export bacon that they could not be graded.[b] The opinion of the packer in one of the earlier tests has already been mentioned. (See pp. 207–208.) In a breed test inaugurated in collaboration with the Dominion department of agriculture the Yorkshires and Berkshires were the only breeds that made a satisfactory showing. "There were practically no culls among these breeds."[c]

THE EFFECT OF HOG RAISING ON THE FERTILITY OF THE LAND.

Following the grazing experiments, in 1898, with pigs on peanuts, chufas, and soy beans, Bennett[d] noted the effect which the grazing of the pigs and the growth of the various crops had on the soil and the cotton yield per acre. The effect was noted during the year immediately following the grazing and also for the second year. planting to ground on which corn had been grown the year before A plat of cotton was used as a check. The results, showing the

[a] Bul. No. 48, p. 429, Iowa Expt. Sta.
[b] An. Rpt., 1900, p. 48, Ontario Agricultural College.
[c] Rpt., 1901, p. 62, Ontario Agricultural College.
[d] Bul. No. 68, Arkansas Expt. Sta.

amount of seed cotton produced per acre, were as follows for the first year:

	Pounds.
Cotton following peanuts grazed by pigs	1,771
Cotton following chufas grazed by pigs	1,200
Cotton following soy beans grazed by pigs	1,588
Cotton following corn cut and stover removed	1,005

The effect of the grazing was similarly shown in the cotton yield during the second year, although the yields are said to have been decreased by unfavorable climatic conditions. The following statement shows the amount of seed cotton produced per acre the second year after grazing:

	Pounds.
Second crop cotton following peanuts	1,134
Second crop cotton following chufas	981
Second crop cotton following soy beans	1,020
Second crop cotton following corn	798

These figures show that during the first year after grazing on peanuts, soy beans, and chufas the manure left by the pigs, supplemented by the fertilizing properties of the plants themselves, increased the yield of seed cotton from nearly 20 to more than 76 per cent per acre over the yield from a plat where corn had been grown; and that during the second year the yield in favor of the grazed plats was still apparent, ranging from over 22 per cent to over 42 per cent more on the grazed than on the ungrazed plats. Naturally some of the increased yield must be attributed to the fertilizing value of the peanuts and soy beans, but as chufas are not leguminous plants and, therefore, are not equipped with nitrogen-gathering bacteria, the figures where they were used show quite accurately the manurial effect of the grazing. The increased yield on the chufa-grazed plats was nearly 20 per cent the first year after grazing and over 22 per cent the second year after.

In reporting the Tennessee experiments Soule and Fain estimated the value of the manure made by the pigs. The method of calculation used in the experiment of 1901 is not explained. In the experiments of 1902–3 the available manure was estimated at 75 per cent of the excrement voided by the animals, and its value was calculated by estimating nitrogen at 15 cents per pound, potash at 5 cents, and phosphoric acid at 5 cents. The following shows the value of the manure made during the experiment of 1901:

Value of manure in pig feeding.

Ration.	Number of pigs.	Number of days fed.	Value of manure
Corn meal	3	60	$2.16
Corn meal and skim milk	3	60	4.12
Corn meal, wheat meal, and dairy by-products	3	60	3.40
Corn meal, cowpea hay, and skim milk	2	60	2.15

The following shows the estimated value of the manure made during the experiments of 1902–3. There were 3 pigs in each lot in the tests of 1902 and 4 in each lot in 1903. They were fed sixty days in 1902 and seventy-seven days in 1903:

Value of manure in pig feeding.

Ration.	Value of manure.
Wheat meal, corn meal, and skim milk	$3.43
Wheat meal, corn meal, and skim milk	4.34
Wheat meal, corn meal, and skim milk	5.00
Wheat meal, corn meal, and skim milk	5.23
Wheat meal, corn meal, and skim milk	4.18
Soy-bean meal, corn meal, and skim milk	4.91
Corn meal and skim milk	4.04
Corn meal	1.20

The high fertilizing value of rations composed to a considerable extent of nitrogenous feeds, such as the skim-milk rations and the soy-bean-meal ration, is apparent.

The value of the manure as a by-product of animal husbandry can not be too strongly emphasized, especially in those sections of the country, like the South, where the fertility of the land has, to a certain extent, been lost. The South supports the greater part of the business of the country in commercial fertilizers, and, while paying enormous sums annually in this manner, can not look forward to anything but greater impoverishment of the soil unless the production of live stock is increased and the manure carefully utilized.

INFLUENCE OF PROTEIN AND MINERAL MATTER ON ECONOMY OF GAIN.

The Kansas Station[a] studied the relative effects of rations, rich and poor, in protein and mineral matter in their effects on the cost of gain, with the following results:

Value of protein and mineral matter in feeding pigs.

Ration.	Protein.	Mineral matter.	Feed for 100 pounds gain.
	Pounds.	*Pounds.*	*Pounds.*
Corn 66⅔ pounds, soy beans 33⅓ pounds	15.1	2.6	369
Kafir corn 66⅔ pounds, soy beans 33⅓ pounds	14.8	3.3	374
Kafir corn 80 pounds, soy beans 20 pounds	11.8	2.9	408 to 468
Corn 100 pounds	7.8	1.5	457 to 479
Kafir corn 100 pounds	7.3	2.5	471 to 749

This station calls attention to the need of mineral matter in a pig's ration, which is not supplied by Indian or Kafir corn. In experiments where pigs were confined in a stone piggery and fed either of these grains exclusively they craved mineral matter to such an extent "that they ate the mortar from between the stones."

To supply the needed protein where corn or Kafir corn forms the

[a] Bul. No. 95.

basis of fattening, soy beans are recommended, as they are regarded as the richest feed in protein raised on Kansas farms.

BONE MEAL IN A CORN-MEAL RATION.

It is generally understood that a strictly corn or corn-meal diet does not supply a sufficient amount of bone-making material (potash and phosphoric acid) to supply the wants of the animal body, and this is one reason that corn is so strongly condemned for young and growing animals. At the Cornell Station[a] Clinton fed bone meal in small amounts to pigs on corn and milk, and to others a mixture of corn meal and middlings and milk. The amount in the first trial was 1 ounce of bone meal to each 500 pounds of live weight daily; that in the second was not stated. In the first test "it did not produce any apparent results upon the health of the animals or upon the economy in the use of foods;" in the second "the bone meal seems to have produced beneficial results when fed in conjunction with the corn-meal ration, but not when fed with the grain mixture." Skim milk doubtless minimized considerably the possible effects of the bone meal.

RESULTS AT DIFFERENT PERIODS OF GROWTH.

Relative production of pork before and after weaning.—At the Alabama Station Duggar[b] fed a sow and her litter of 7 pigs from the time of farrowing, February 24, to April 1, 1899, in a bare lot on a mixture of equal parts by weight of ground cowpeas and very coarse rice meal, consisting largely of rice chaff. The sow and pigs ate 273 pounds of the meal, the sow losing 29.6 pounds in this time and the pigs gaining 67.3 pounds, making a net gain of pork produced of 37.7 pounds, an average daily gain for the pigs during the thirty-five days of 0.15 pound.

On April 1 the sow and litter were placed in hurdles on a field of hairy vetches and turf oats, which were sown the previous October on poor upland soil. The sow was removed after five weeks, but the pigs continued for three weeks longer, making a net average daily gain of 0.13 pound.

The following table shows the results of this experiment:

Feed ng pigs before and after weaning.

	Before weaning.	After weaning.
Number of pigs	7	7
Weight of pigs at beginning ..... Pounds	118.60	232.9
Gain of pigs .....do	113.60	55.0
Loss of sow .....do	19.60	.....
Net gain of sow and pigs .....do	94.20	.....
Average daily gain of pigs .....do	.46	.2
Average net daily gain of sow and pigs .....do	.34	.....
Meal consumed by sow and pigs .....do	554.20	[c]244.0
Meal per pound gain of pigs .....do	488.00	440.0
Meal per 100 pounds net gain of sow and pigs .....do	588.00	.....
Total weight of sow and pigs at beginning .....do	350.30	.....

[a] Bul. No. 190. [b] Bul. No. 122. [c] Only pigs during last three weeks.

These results show that the losses in weight of the sows, due to the drain of milking, make the production of pork while the pigs are on the dams a somewhat expensive business. Sows differ considerably in their ability to give large milk yields without consequent losses in weight. There have been cases where very good gains were made by the sow while suckling a litter (see p. 179). Duggar[a] is of the opinion that it is quite possible to maintain weight while suckling, provided the sow is given a nutritious ration. In an experiment where he fed a sow and her litter of 9 pigs on Spanish peanuts, corn meal, and skim milk the sow gained 9 pounds in weight in thirty-five days and the pigs 227 pounds, a total gain of 236 pounds. The cost of the grain and skim milk per 100 pounds gain was $2.50. Duggar regards this test as evidence "that on a sufficiently nutritious and palatable diet the weight of the nursing sow can be maintained."

Gains of pigs at various weights.—Linfield[b] averaged his results of experiments to show the gains of hogs at various weights. The table showing these averages is as follows:

Gains of pigs at various weights.

Weight.	Ration.	Number of tests.	Number of pigs.	Average daily gain.	Dry matter eaten daily.	Digestible matter eaten daily.	Feed per 100 pounds gain.		Dry matter per 100 pounds gain.	Digestible matter to 100 pounds gain.	Grain equal to 100 pounds skim milk.
							Grain.	Milk.			
				Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
From 44 to 102 pounds live weight.	Milk and grain.	9	31	1.12	2.79	2.25	194	829	250	203	28.4
	Grain	6	16	.80	3.03	2.30	430	.....	385	292	.....
	Milk	4	11	.75	1.88	1.79	.....	2,838	257	244	15.1
From 102 to 152 pounds live weight.	Milk and grain.	10	34	1.42	4.93	3.93	297	879	348	277	13.6
	Grain	4	12	1.18	4.40	3.34	417	.....	373	283	.....
From 152 to 199 pounds live weight.	Milk and grain.	8	27	1.51	5.74	4.52	357	717	381	304	28.7
	Grain	2	6	1.12	5.65	4.32	563	.....	501	383	.....
From 200 to 255 pounds live weight.	Milk and grain.	5	19	1.39	5.79	4.51	409	590	422	329	27.8
	Grain	1	2	.97	5.83	4.44	673	.....	599	457	.....

These results generally corroborate the views of previous authorities on the subject of the influence of increasing age on the rate and economy of gain. A noticeable fact is that, except for the grain-fed lots, the economy of gain was greatest in the youngest pigs, decreasing as the pigs became older. With the grain-fed pigs the cheapest gains were made from 102 to 152 pounds, but after this weight the increase in cost of gain was rapid. The rate of gain is not so uniform, but the figures show pretty clearly that the greatest gains were made from 102 to 152 pounds, although those pigs on milk and grain made the largest gains from 152 to 199 pounds.

[a] Bul. No. 122, Alabama Expt. Sta. [b] Bul. No. 57, Utah Expt. Sta.

WATER DRUNK AT VARIOUS WEIGHTS.

From data reported by the Indiana Station[a] to study the effect of water in the feed, the writer has compiled a table showing the amount of water consumed during the experiment. The following table shows some of the leading features of this experiment:

Daily consumption of water at approximate weights.

Lot.	Ration.	Number of pigs.	Daily consumption of water by pigs weighing—								
			60 lbs.	70 lbs.	80 lbs.	90 lbs.	105 lbs.	125 lbs.	156 lbs.	180 lbs.	215 lbs.
			Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
Lot I	Grain (dry)	4	2.35	3.00	2.42	4.21	4.82	7.50	11.42	9.44	11.0
Lot II	Grain and water (1:1).	4	2.42	3.27	3.35	3.27	4.50	5.60	7.50	8.39	8.1
Lot III	Grain and water (1:2).	4	4.25	6.03	6.00	6.00	7.00	9.00	11.00	14.00	14.0
Lot IV	Grain and water (1:3).	4	5.79	8.25	9.00	9.00	10.50	13.50	16.50	18.00	18.0

These figures show little difference in the consumption of water when feed was given dry and when mixed with an equal weight of water. The increase of the consumption of water with age is gradual, but not regular. The pigs that were forced to drink large quantities of water to get enough feed to satisfy hunger evidently drank more than they needed, if the figures of the dry-grain lot are a criterion.

GAIN OF PIGS FOLLOWING CATTLE.

Morrow and Bone,[b] in Oklahoma, report a case where 5 pigs following steers that were full fed on corn and Kafir meal "gained only 195 pounds, or 39 pounds each, in fifty-six days. In another case 5 pigs gained 100 pounds in fifty-six days; and in a third 6 moderate-sized sows gained 245 pounds in fifty-six days."

BARROWS COMPARED WITH SOWS.

Foster and Merrill, in Utah,[c] made two tests to compare the relative fattening values of barrows and sows. In the first test of ninety-one days, 6 barrows made an average daily gain of 0.9 pound, and 3 sows an average daily gain of 0.83 pound; in the second test of one hundred and thirty-three days, 3 barrows made an average daily gain of 0.7 pound, and 6 sows an average daily gain of 0.88 pound.

SPAYED COMPARED WITH UNSPAYED SOWS.

The same station fed 6 half-blood Berkshire sows, 3 of which were spayed and 3 were not, on a varied diet for one hundred and sixteen days.[c] The spayed sows made a daily average gain of 0.82 pound, and the unspayed sows an average daily gain of 0.86 pound. No difference of appetite was noticed.

[a] Bul. No. 86.

[b] An. Rpt., 1898–99, Oklahoma Expt. Sta.

[c] Bul. No. 70, Utah Expt. Sta.

BUTCHERS' TERMS.

Very frequently experiment station literature on animal husbandry contains reference and tables relating to slaughter tests in packing houses. The following definitions of the terms applied to the offal and the uses of these parts have been supplied by Dr. U. G. Houck, Inspector, Bureau of Animal Industry, National Stock Yards, Ill. In this connection, the reader may find it interesting to refer to the definitions on page 186:

Melt (spleen): Uses: Tanked in offal tank.

Head, gross: Weight of head before any portion has been trimmed away.

Head, net: Head after tongue, jowls (cheeks), snout, and ears have been trimmed away.

Tongue: Uses: Boiled and pickled.

Cheek meat: Masseter muscles (*masseter externus* and *ptyerygoideus internus*). Uses: Sausage.

Cheek-meat fat: Small pieces of the fatty portion of the jowls that are unintentionally left attached to the masseter muscles when the jowls are trimmed away. Uses: Rendered into lard.

Leaf lard: A thick layer of fat extending anteroposteriorly and attached to the sublumbar and lateral abdominal parietes. Uses: Lard.

Kidneys: Uses: Human food; also one of the ingredients in the manufacture of chicken and dog feeds.

Gullet: Includes larynx, short pieces (3–6 in.) each of the trachea and esophagus and the fat attached to the parts. Uses: Fat trimmed away for lard and the remaining parts tanked in the grease tank.

Gullet fat: Fat at base of tongue that remains attached to the gullets when they are removed from the carcass. Uses: Lard.

Ham facings: Fat of the internal crural region that is removed in facing or trimming the hams. Uses: Lard.

Pluck: The term properly includes larynx, trachea, esophagus, heart, lungs, liver, a portion of the diaphragm ("skirt"), and the fat of the parts. Sometimes the lungs alone are spoken of as plucks.

Livers: In test the liver is weighed before it has been trimmed of the gall bladder and ligamentous portions. Uses: When not used in liver sausage, it is tanked in the offal tank. Sometimes used in the manufacture of prepared chicken and dog feed.

Heart: Uses: Sausage.

Lungs: In test this refers to weight of lung tissue only; the mediastinal ("heart") fat having been trimmed away for lard purposes. Uses: Offal tank.

Bladders, gross: In test includes urine contained in bladder when removed, also attached fat.

Bladders, net: Weight of bladder when empty and trimmed of fat.

Bladder fat: Some of the pelvis fat ("crotch fat") is cut away with the neck of the bladder when it is removed from the carcass. Uses: Lard.

Total weight of guts: Weight of stomach, intestinal tube, intestinal contents, and attached fat.

Gut fat: Fat of the cecum and colon, together called the "black gut;" they are emptied, washed, and tanked. Uses: Lard.

Caul and ruffle: Caul fat means the fat of the omentum. Ruffle fat is the fat of the great and colic mesenteries. Uses: Lard.

Bung guts, gross: Weight of the posterior end of the intestinal tube (rectum and 4 to 6 feet of the colon), the intestinal contents, and the attached fat.

Bung guts, net: Weight of the bung guts after they have been emptied and the fat trimmed off. Uses: The bung gut is used for sausage casings.

Bung-gut fat: The fat that is trimmed from the bung guts. This includes the "knob fat," which is a bunch of fat about the size of a man's fist that is removed from the carcass with the anus. Uses: Lard.

Small guts, gross: Weight of duodenum, jejunum, ileum, their contents and fat attached.

Small guts, net: Weight of the duodenum, jejunum, and ileum after they have been emptied, washed, and trimmed. Uses: Sausage casings.

Paunches, gross: Weight of stomach and contents.

Paunches, net: Weight of stomachs after they have been emptied and trimmed. Uses: They are filled with lard or used for the casings of head cheese. Pepsin is manufactured from some portions, and they may be rendered in the lard tank.

Pig bags (uteri): Uses: Offal tank.

Head meat: Includes the "cheek meat," "skull meat," and the "temporal," or "pate," meat.

Cheek meat: Explained above.

Skull meat: Refers to the portions of the supra-cervical muscles, principally the rectuli copitii muscles, that remain attached to the parietal ridges of the occipital bone. Uses: Sausage.

Temporal, or pate, meat: Refers to the muscles filling the temporal fossa. Uses: Sausage.

Pizzle (penis): Uses: Offal tank.

Pouch: Prepuce and the surrounding bunch of connective tissue and fat. Uses: Offal tank.

Pizzle fat: Refers to the fat of the "pouch." Uses: Offal tank.

Kidney fat (leaf lard): Uses: Lard.

Crotch fat: Refers to the intra-pelvic fat. Uses: Lard.

Weasand (esophagus): Uses: Grease tank.

Weasand meat: Muscular portion of the esophagus. Uses: Of hogs not saved. grease tank.

Stomach lining: Refers to the mucous membrane of the cardiac end of the stomach from which pepsin is made.

Chitterling (cecum): Uses: Some people cook it. Usually tanked in offal tank.

Snouts: Refers to the nose and portion of the upper lip. Uses: Pickled for food.

Sweetbreads: In hogs this refers to the pancreas only. Uses: Sometimes cooked for food. In the packing house they are usually consigned to the lard tank.

Giblets, or giblet trimmings: Refers to that portion of the pillars of the diaphragm that is cut away with the pluck when it is removed. Uses: Sausage.

Gut scrapings: Refers to the mucous membrane lining of the intestines that is scraped away in preparing casings. May include small portion of the ruffle fat that is unintentionally left on the gut. Uses: Offal tank.

Feet: Uses: Boiled and pickled for food.

Brains: Uses: Cooked for food.

Tails: Uses: Cooked for food.

Blood: Uses: As food, in the arts, in the manufacture of albumen, or for fertilizer.

STATISTICS OF PRODUCTION AND TRADE.

STATISTICS OF PRODUCTION AND TRADE.

THE CENSUS RETURNS.

The Twelfth Census reports the total number of hogs on farms and ranges in the United States on June 1, 1900, excluding Alaska and Hawaii, as 62,868,041, with an estimated total value of $231,978,031. This is a ratio of 827 hogs per 1,000 inhabitants. "In the collection of the statistics of live stock, tabulated in the census of agriculture for 1900, three schedules were used. The first of these, known as the general farm schedule, was used by the enumerators in collecting data from the operators of farms, plantations, and ranges in all parts of the country. The second schedule was used by the special agents in recording the statistics of the larger ranches of the great West and Southwest, especially those making use of the range or public domain in sparsely settled sections of the country, where they might have been overlooked by the enumerators, or from which imperfect reports were likely to have been obtained. The third schedule was used by enumerators in collecting reports of domestic animals not on farms or ranges, especially those found in cities and villages." The foregoing figures are those of hogs on farms and ranges. This was 97.2 per cent of the total number reported. Those "in barns and inclosures elsewhere" were 1,818,114. There were 10 hogs on farms and ranges in Alaska, with an average value of $10 each, and 8,057 on farms and ranges in Hawaii, with an average value of $6.15 each.

The following table shows the returns for hogs for the United States, by States and Territories, the ratio to population, to land area and to farm area, and the average and total valuations. The farm areas used in calculating the figures in the fifth column were those reported by the Census Office, which defined a farm under the Twelfth Census as including "all the land under one management used for raising crops and pasturing live stock, with the wood lots, swamps, meadows, etc., connected therewith. It includes also the house in which the farmer resides, and all other buildings used by him in connection with his farming operations."

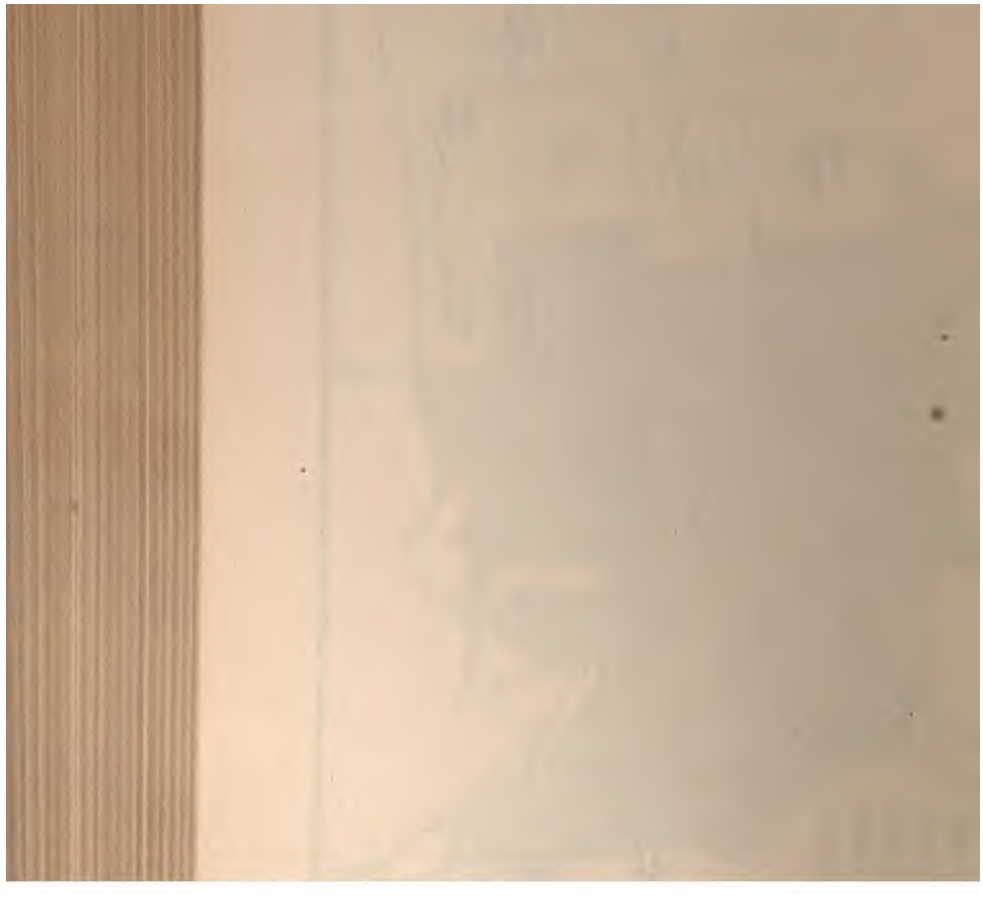
Hogs on farms and ranges in the United States in 1900.[a]

States and Territories.	Total number.	Ratio per 1,000 inhabitants.	Ratio per square mile, land area.	Ratio per square mile, farm area.	Average value.	Total value.
United States	62,866,041	827	21	45	$3.69	$231,973,021
North Atlantic division	2,382,268	110	14	23	5.60	13,011,021
Maine	79,018	114	3	3	6.53	516,035
New Hampshire	51,211	124	6	9	6.96	357,523
Vermont	95,090	277	10	13	6.82	650,169
Massachusetts	73,935	23	10	16	6.96	509,617
Rhode Island	11,908	27	11	16	7.67	90,614
Connecticut	46,447	51	10	13	7.04	326,857
New York	676,689	93	14	19	5.61	3,794,922
New Jersey	175,367	93	23	40	5.26	923,179
Pennsylvania	1,107,991	176	25	27	5.26	5,830,225
South Atlantic division	5,562,769	393	21	34	2.29	12,736,767
Delaware	46,729	223	24	28	5.02	234,472
Maryland	317,909	265	23	39	4.18	1,329,143
District of Columbia	809	3	13	60	5.11	4,087
Virginia	946,443	510	24	39	2.72	2,572,891
West Virginia	442,344	462	18	27	3.14	1,389,289
North Carolina	1,800,469	667	37	37	1.94	2,516,419
South Carolina	613,985	462	21	28	2.28	1,411,516
Georgia	1,494,298	643	24	25	1.81	2,677,289
Florida	464,277	878	9	68	1.51	702,827
North Central division	40,474,289	1,537	54	82	4.15	167,776,262
Ohio	3,188,563	767	78	83	3.70	11,813,168
Indiana	3,763,389	1,496	105	111	3.67	13,804,763
Illinois	5,915,468	1,227	106	115	3.99	23,616,791
Michigan	1,165,200	481	20	42	3.94	4,588,888
Wisconsin	2,014,631	974	37	65	3.76	7,580,623
Minnesota	1,440,806	823	18	35	4.07	5,865,380
Iowa	9,723,791	4,357	175	180	4.50	43,764,176
Missouri	4,524,664	1,456	66	85	3.65	16,538,935
North Dakota	191,796	601	3	8	4.85	930,470
South Dakota	823,120	2,050	11	28	4.30	3,540,022
Nebraska	4,126,000	3,871	54	88	4.52	18,660,932
Kansas	3,594,859	2,445	44	55	4.75	17,076,904
South Central division	13,047,827	927	21	32	2.47	32,233,504
Kentucky	1,954,537	910	49	57	2.65	5,176,183
Tennessee	1,976,984	978	47	62	2.45	4,838,713
Alabama	1,423,329	778	28	44	2.03	2,887,220
Mississippi	1,290,498	833	28	45	2.30	2,963,573
Louisiana	788,425	571	17	46	1.90	1,494,294
Texas	2,665,614	874	10	14	2.85	7,605,687
Oklahoma	584,878	1,468	15	24	4.07	2,380,025
Indian Territory	650,255	1,659	21	57	2.93	1,905,200
Arkansas	1,713,307	1,308	32	66	1.74	2,981,309

[a] Excluding Alaska and Hawaii.

NUMBER OF HOGS IN EACH STATE AND RATIO PER 1,000 POPULATION (CENSUS OF 1900).

NUMBER OF HOGS IN EACH STATE AND RATIO PER SQUARE MILE OF LAND AREA (CENSUS OF 1900).



NUMBER OF HOGS IN EACH STATE AND RATIO PER SQUARE MILE OF FARM AREA (CENSUS OF 1900).

Hogs on farms and ranges in the United States in 1900—Continued.

States and Territories.	Total number.	Ratio per 1,000 inhabitants.	Ratio per square mile, land area.	Ratio per square mile, farm area.	Average value.	Total value.
Western division	1,460,957	357	1	10	$4.26	$6,218,187
Montana	49,496	208	.3	3	5.69	281,402
Wyoming	15,471	167	.2	1	5.05	78,145
Colorado	101,198	188	1	7	4.77	482,722
New Mexico	20,426	105	.2	3	4.00	81,644
Arizona	18,108	147	.2	6	4.45	80,587
Utah	65,732	238	1	10	4.46	293,115
Nevada	15,174	358	.1	4	4.99	75,712
Idaho	114,080	705	1	23	4.21	480,338
Washington	161,595	350	3	14	4.58	830,704
Oregon	291,498	680	3	18	3.76	1,057,037
California	388,677	403	4	13	4.14	2,476,781

The following table shows the same facts as the preceding one, but the States are arranged so as to show particularly the overwhelming production of hogs in the corn belt. The arrangement was made with the view to grouping the States, as nearly as possible, according to (1) crops produced and climatic conditions, (2) the character of the hogs raised, and (3) proximity to market:

Hog production in the United States as related to crops, climate, and markets.

States and Territories.	Total number.	Ratio per 1,000 inhabitants.	Ratio per square mile, land area.	Ratio per square mile, farm area.	Average value.	Total value.
United States	62,622,041	827	21	48	$3.69	$231,236,681
The East and New England:						
Maine	79,013	114	3	8	6.53	516,015
New Hampshire	51,211	124	6	9	6.96	357,573
Vermont	95,090	277	10	13	6.52	620,169
Massachusetts	78,985	28	10	16	6.96	549,617
Rhode Island	11,508	27	11	16	7.87	90,614
Connecticut	46,447	51	10	13	7.04	326,857
New York	676,630	93	14	19	5.61	3,794,332
New Jersey	175,397	98	23	40	5.28	926,179
Pennsylvania	1,107,981	176	25	37	5.26	5,830,265
Delaware	46,722	253	24	25	5.02	234,472
Maryland	317,992	268	32	39	4.18	1,329,143
District of Columbia	802	3	13	60	5.11	4,097
Total	2,687,649	118	15	24	5.42	14,579,363
The South:						
Virginia	946,443	510	24	30	2.72	2,572,524
North Carolina	1,300,469	667	27	37	1.94	2,516,410
South Carolina	618,995	462	21	28	2.28	1,411,516
Georgia	1,494,208	643	24	35	1.81	2,577,950

Hog production in the United States as related to crops, etc.—Continued.

States and Territories.	Total number.	Ratio per 1,000 inhabitants.	Ratio per square mile, land area.	Ratio per square mile, farm area.	Average value.	Total value.
The South—Continued.						
Florida	464,277	878	9	66	$1.51	$702,057
Alabama	1,493,359	778	26	44	2.03	2,897,239
Mississippi	1,260,496	888	26	45	2.20	2,903,513
Louisiana	788,435	571	17	46	1.90	1,494,294
Arkansas	1,713,307	1,206	32	66	1.74	2,981,239
Tennessee	1,976,994	978	47	89	2.45	4,839,713
Kentucky	1,954,887	910	46	57	2.65	5,178,193
West Virginia	442,844	402	18	27	3.14	1,389,889
Total	14,344,406	754	27	44	2.20	31,512,287
The southwest range States:						
Indian Territory	650,255	1,699	21	57	2.98	1,938,259
Oklahoma	854,878	1,498	15	24	4.07	2,289,055
Texas	3,695,614	574	10	14	2.65	7,695,657
New Mexico	20,436	105	.2	3	4.00	81,644
Arizona	18,103	147	.2	6	4.45	89,287
Total	3,639,276	943	7	16	3.06	12,054,142
The corn belt:						
Missouri	4,324,664	1,498	65	65	3.65	16,533,655
Kansas	3,594,833	2,445	44	55	4.75	17,076,694
Nebraska	4,126,000	2,871	54	66	4.52	18,668,992
Iowa	9,732,791	4,557	175	180	4.50	43,794,176
Illinois	5,915,466	1,227	106	115	3.99	23,616,731
Indiana	3,763,389	1,496	105	111	3.67	13,804,968
Ohio	3,188,563	767	78	83	3.70	11,813,169
Total	34,838,734	1,799	84	102	4.17	145,270,789
States north of the corn belt:						
Michigan	1,165,200	481	20	42	3.94	4,589,688
Wisconsin	2,014,631	974	37	65	3.76	7,580,635
Minnesota	1,440,806	823	18	35	4.07	5,865,339
North Dakota	191,798	601	3	8	4.85	930,479
South Dakota	823,120	2,050	11	28	4.20	3,549,052
Total	5,635,555	809	17	37	3.99	22,515,453
The northwest range States:						
Montana	49,496	208	.3	3	5.69	281,682
Wyoming	15,471	167	.2	1	5.05	78,165
Colorado	101,198	188	1	7	4.77	482,732
Utah	65,732	238	1	10	4.46	293,115
Nevada	15,174	358	.1	4	4.99	75,712
Idaho	114,080	705	1	23	4.21	480,239
Total	361,151	266	.6	6	4.68	1,691,645
The Pacific coast:						
Washington	181,535	350	3	14	4.58	833,704
Oregon	281,406	680	3	18	3.76	1,057,657
California	598,336	408	4	13	4.14	2,476,781
Total	1,061,277	439	3	14	4.11	4,364,142

An examination of these tables shows that in point of numbers Iowa leads, with 9,723,791; Illinois is second, with 5,915,468. There are four States—Iowa, Illinois, Missouri, and Nebraska—with over 4,000,000 hogs, and nineteen that have over 1,000,000; seventeen States and Territories have from 100,000 to 1,000,000 hogs; fourteen have less than 100,000; and Rhode Island, the District of Columbia, New Mexico, Arizona, Wyoming, and Nevada have less than 25,000.

The proportion of hogs to population has a direct bearing on the supply of pork in relation to consumption. On this point we find that Iowa has 4,357 hogs per 1,000 inhabitants, Nebraska being next with 3,871 per 1,000 inhabitants. Eight other States have over 1,000 hogs per 1,000 inhabitants; nine have from 750 to 1,000 hogs per 1,000 inhabitants; and sixteen have more than the average for the nation, which is 827. Fifteen States and Territories have fewer than 250 hogs per 1,000 inhabitants, and six have fewer than 100.

The ratios to land and farm area bear directly on the productive capacity of the country. The third column shows this ratio for the land area regardless of the state of cultivation, including, of course, considerable uninhabitable land. Iowa leads with 175 hogs per square mile, Illinois and Indiana having 106 and 105, respectively. In addition to these States, Missouri, Nebraska, and Ohio have over 50 hogs per square mile; twenty-two States and Territories have a number equal to or exceeding 21, the average for the entire country; fifteen have less than 10 hogs per square mile.

The next column more nearly shows the actual production of hogs by the farms than the preceding one dealing with the land area. Iowa again leads, with 180 hogs per square mile, Illinois and Indiana being second and third, with 115 and 111, respectively. In addition to these States eleven have over 50 hogs per square mile of farm area. No others are above the average for the nation—48. Nine States and Territories have fewer than 10 hogs per square mile of farm area.

The State of Rhode Island reports the highest average value, $7.87; Connecticut is second, with $7.04. The Southern States report the lowest average values, which, in spite of the fact that they have large numbers, brings the total values down. For instance, New York has 676,639 hogs, with a total value of $3,794,332; while Georgia, with 1,424,298, Alabama, with 1,423,329, and Arkansas, with 1,713,307, have each over twice as many hogs as New York, but the total values are considerably less, being 21.44 per cent less in the case of Arkansas, 23.90 per cent less in the case of Alabama, and 32.05 per cent less in the case of Georgia.

In considering the groups in the second table the predominance of those States that are particularly corn-growing districts is at once apparent. This group of seven States has 34,838,734 hogs, which is 55.39 per cent of the total on farms and ranges in the United States. The ratio per 1,000 inhabitants is 1,799—twice as great as the aver-

age; the ratio per square mile of land area is 84—four times the average for the entire country; and the ratio per square mile of farm area is 102—twice the general average. In average valuation alone the corn belt fails to lead the nation.

The States that form the southwestern range follow the corn-belt States in ratio per 1,000 inhabitants, this being 948, but are low in ratio per square mile of land and farm area. The other groups follow in this order: The States north of the corn belt, with 809 per 1,000 inhabitants; the South, with 754 per 1,000 inhabitants; the Pacific coast, with 439 per 1,000 inhabitants; the northwestern range States, with 266 per 1,000 inhabitants; the East, with 118 per 1,000 inhabitants. In ratios per square mile of land area the corn belt leads with 84, the other groups following thus: The South, with 27; States north of the corn belt, with 17; the East, with 15; the Southwest, with 7; the Pacific coast, with 3; the Northwest, with 0.6. In ratio per square mile of farm area the order is as follows: The corn belt, 102; the South, 44; States north of the corn belt, 37; the East, 24; the Southwest, 16; the Pacific coast, 14; the Northwest, 6. The Eastern States lead in average valuation, with $5.42; the northwestern range States second, with $4.68; the corn belt is third, with $4.17, and the remainder as follows: The Pacific coast, with $4.11; States north of the corn belt, with $3.99; the Southwest, $3.06; the South, $2.20.

The relative positions of these groups are consolidated into the following table:

Production of hogs in United States, by regions.

Group.	Total number on farms and ranges.	Ratio per 1,000 inhabitants.	Ratio per square mile, land area.	Ratio per square mile, farm area.	Average value
Corn belt	First	First	First	First	Third.
South	Second	Fourth	Second	Second	Seventh.
States north of corn belt	Third	Third	Third	Third	Fifth.
Southwest	Fourth	Second	Fifth	Fifth	Sixth.
East	Fifth	Seventh	Fourth	Fourth	First.
Pacific coast	Sixth	Fifth	Sixth	Sixth	Fourth
Northwest	Seventh	Sixth	Seventh	Seventh	Second

TRADE STATISTICS.

THE DOMESTIC TRADE.

Before giving the following statistics it should be explained that the pork-packing year ends March 1 and is divided into two seasons—the summer season of eight months, from March 1 to November 1, and the winter season of four months, from November 1 to March 1. This system came into vogue before the days of artificial refrigeration, and, although such a designation is no longer necessary, it is

still adhered to by statisticians. The figures for packing in the West (packing centers in the corn belt or States contiguous to it) are much more accurate than those for the rest of the country, where reports of operations are not so completely published.

TOTAL COST OF HOGS SLAUGHTERED.

The Cincinnati Price Current reports the total cost of hogs purchased by Western packers during the year ended March 1, 1903, as $313 537,000. The approximate cost of hogs slaughtered in the East is estimated at $67,000,000, making a total of $380,537,000, which does not include the immense number of animals killed on small farms or in towns, for which there are no commercial reports and no means of making accurate estimates. This is 2.01 per cent less than the cost for the preceding year, but over 90.11 per cent greater than the cost for the year ended March 1, 1892. The following table shows these facts in detail for the past thirteen years:

Cost of hogs slaughtered annually.

Years.	Western packing.	Eastern slaughtering.	Total.	Years.	Western packing.	Eastern slaughtering.	Total.
1902–03	$313,537,000	$67,000,000	$380,537,000	1895–96	$142,268,000	$48,000,000	$190,268,000
1901–02	323,346,000	65,000,000	388,346,000	1894–95	172,679,000	56,000,000	228,679,000
1900–01	274,680,000	58,000,000	332,680,000	1893–94	166,090,000	64,000,000	230,090,000
1899–00	212,850,000	55,000,000	267,858,000	1892–93	155,766,000	69,000,000	224,766,000
1898–99	203,696,000	50,000,000	253,696,000	1891–92	141,698,000	58,000,000	199,698,000
1897–98	174,382,000	48,000,000	222,382,000	1890–91	158,445,000	52,000,000	210,445,000
1896–97	135,456,000	42,000,000	177,456,000	1889–90	134,169,000	47,000,000	181,169,000

YEARLY COMPARISONS OF PORK PACKING.

The following table shows, by seasons and total, the number of hogs packed in the West, the total amount of green meats and lard produced, and the total cost of hogs since the year ended March 1, 1872. It will be noticed that the year ended March 1, 1902, shows the greatest number of hogs packed during any of the years given, the greatest production of green meats, except for the year 1898–99, and the greatest amount of lard except for the years 1898–99 and 1900–01. The reason for these differences is apparent when reference is made to the table showing lard averages, where it is seen that the average weight of hogs sold during the winter season of 1901–02 was the least for any year reported. The rush of light, unfinished hogs to market during the drouth of 1901 and the succeeding period of high prices for feed was the cause of this falling off in weight. Comparing with the year ended March 1, 1892, we see that during the packing year of 1901–02 there were marketed 10,954,062 more hogs than during the

year 1891–92, an increase of 75 per cent; there were produced 1,098,097,000 pounds more of green meats and 324,084,000 pounds more of lard, increases of 55 per cent and 67 per cent, respectively:

Yearly comparisons of pork packing in the West.

[Cincinnati Price Current.]

Years.	Total number of hogs packed in the West.			Green meats produced.	Total lard produced.	Total cost of hogs.
	Summer season.	Winter season.	Year ended Mar. 1.			
	Number.	*Number.*	*Number.*	*Pounds.*	*Pounds.*	*Dollars.*
1872-73	505,500	5,410,314	5,915,814	955,390,000	224,810,000	64,135,000
1873-74	1,062,916	5,466,200	6,529,116	978,850,000	228,610,000	75,592,000
1874-75	1,200,444	5,566,226	6,766,670	903,847,000	231,180,000	112,963,000
1875-76	1,262,343	4,880,135	6,142,478	900,407,000	208,831,000	116,407,000
1876-77	2,307,866	5,101,308	7,409,174	1,068,450,000	243,919,000	115,965,000
1877-78	2,543,120	6,505,446	9,048,566	1,398,612,000	336,557,000	106,418,000
1878-79	3,378,044	7,480,648	10,858,702	1,579,311,000	408,702,000	94,980,000
1879-80	4,051,248	6,950,451	11,001,699	1,556,516,000	382,020,000	119,362,000
1880-81	5,323,898	6,919,456	12,243,354	1,694,253,000	409,875,000	134,944,000
1881-82	4,803,689	5,747,760	10,551,449	1,468,368,000	363,772,000	154,462,000
1882-83	3,210,787	6,132,212	9,342,999	1,315,056,000	316,063,000	154,100,000
1883-84	3,781,036	5,402,064	9,183,100	1,280,065,000	318,472,000	122,388,000
1884-85	4,058,868	6,460,240	10,519,108	1,497,357,000	364,375,000	124,754,000
1885-86	4,964,572	6,298,995	11,263,567	1,577,932,000	390,740,000	106,053,000
1886-87	5,644,003	6,439,009	12,083,012	1,619,126,000	394,118,000	119,935,000
1887-88	5,611,526	5,921,181	11,532,707	1,518,677,000	357,755,000	133,057,000
1888-89	5,315,122	5,483,852	10,798,974	1,499,251,000	359,927,000	140,931,000
1889-90	6,881,501	6,663,802	13,545,303	1,885,424,000	489,727,000	134,169,000
1890-91	9,540,008	8,173,126	17,713,134	2,371,376,000	618,732,000	158,445,000
1891-92	6,636,398	7,761,216	14,457,614	1,907,993,000	479,045,000	141,698,000
1892-93	7,757,110	4,633,520	12,390,630	1,557,111,000	388,985,000	155,766,000
1893-94	6,720,924	4,884,082	11,605,006	1,583,703,000	409,052,000	166,000,000
1894-95	8,812,125	7,191,520	16,003,645	2,072,195,000	533,055,000	172,679,000
1895-96	8,194,835	6,815,800	15,010,635	1,958,255,000	513,467,000	142,298,000
1896-97	9,979,888	6,949,090	16,928,978	2,250,158,000	602,040,000	135,456,000
1897-98	11,760,475	8,440,785	20,201,260	2,659,190,000	721,354,000	174,382,000
1898-99	13,931,550	9,720,145	23,651,695	3,030,000,000	808,473,000	203,606,000
1899-00	13,524,943	8,675,878	22,200,821	2,828,000,000	794,453,000	212,858,000
1900-01	14,322,924	9,277,750	23,600,674	2,983,000,000	805,703,000	274,692,000
1901-02	15,071,480	10,340,196	25,411,676	3,006,000,000	803,129,000	323,306,000
1902-03	12,146,965	8,458,606	20,605,571	2,579,000,000	650,707,000	313,357,000

WEIGHT, AND LARD AVERAGES.

The following table shows the average weight of hogs and the yield of lard in the West for the winter seasons ended March 1, since 1873. Note especially that, while the average weight has decreased from 290.53 pounds in 1873 to 206.38 pounds in 1902, and the yield of lard from 40.08 pounds per hog in the winter season ended March 1, 1873, to 31.30 for the winter season ended March 1, 1902, the percentage of lard yield per hog shows a slight increase.

Average live weight of hogs and yield of lard in the West for the winter seasons ended March 1.

[Cincinnati Price Current.]

Year.	Weight.	Lard.		Year.	Weight.	Lard.	
	Pounds.	*Pounds.*	*Per cent.*		*Pounds.*	*Pounds.*	*Per cent.*
1873	290.53	40.08	13.80	1889	263.46	34.76	13.19
1874	268.71	35.02	13.03	1890	250.92	36.37	14.49
1875	262.21	34.20	13.04	1891	239.75	33.45	13.95
1876	272.13	35.45	13.03	1892	247.64	34.69	14.01
1877	269.90	34.08	12.62	1893	227.73	31.66	13.90
1878	282.55	38.61	13.66	1894	248.20	36.07	14.53
1879	271.42	39.40	14.52	1895	232.73	33.62	14.45
1880	266.17	36.32	13.65	1896	240.71	35.53	14.76
1881	259.63	35.65	13.73	1897	244.80	36.94	15.09
1882	262.70	36.44	13.87	1898	235.35	34.73	14.76
1883	267.02	35.43	13.27	1899	232.65	35.53	15.27
1884	251.44	33.25	13.22	1900	235.67	35.97	15.26
1885	266.51	36.02	13.52	1901	230.31	34.16	14.83
1886	258.98	35.22	13.60	1902	206.38	31.30	15.17
1887	251.31	33.54	13.35	1903	224.05	31.92	14.42
1888	242.80	31.06	12.82				

YEARLY COST OF HOGS.

The following table shows the average cost of hogs for the seasons and years stated. Further on a table of highest prices of hogs is given which must not be confused with this one.

Average cost of hogs packed in the West, per hundred pounds live weight, for years ended March 1.

[Cincinnati Price Current.]

Year.	Summer.	Winter.	Average for year.	Year.	Summer.	Winter.	Average for year.
1880-81	$4.20	$4.61	$4.45	1892-93	$5.03	$6.54	$5.60
1881-82	5.65	6.06	5.90	1893-94	6.33	5.26	5.87
1882-83	7.20	6.28	6.65	1894-95	4.98	4.28	4.67
1883-84	5.60	5.18	5.35	1895-96	4.41	3.68	4.07
1884-85	5.35	4.29	4.70	1896-97	3.30	3.30	3.30
1885-86	3.90	3.66	3.75	1897-98	3.70	3.53	3.63
1886-87	4.10	4.19	4.15	1898-99	3.85	3.52	3.71
1887-88	4.75	5.04	4.90	1899-00	4.00	4.29	4.11
1888-89	5.58	4.99	5.26	1900-01	5.12	5.02	5.07
1889-90	4.30	3.66	3.98	1901-02	5.92	5.97	5.94
1890-91	3.91	3.54	3.74	1902-03	7.06	6.44	6.81
1891-92	4.48	3.91	4.16				

WINTER PACKING IN THE WEST.

The following table shows the total number of hogs packed in the West during the winter seasons, and cost of hogs per 100 pounds live weight since 1842. Before 1873, these figures represent practically

ıe total number of hogs packed in the West for the years given. summer packing began in September of that year, when it is said to have reached the number of 505,500.

Number of hogs packed in the West during the winter seasons, and cost of hogs per 100 pounds live weight.

[Cincinnati Price Current.]

Season.	Number.	Cost.	Season.	Number.	Cost.
9-03	8,458,606	$6.44	1871-72	4,831,558	$4.12
02	10,340,196	5.97	1870-71	3,696,251	5.26
1	9,277,750	5.02	1869-70	2,635,312	9.22
0	8,675,898	4.29	1868-69	2,490,873	8.18
9	9,720,145	3.52	1867-68	2,781,084	6.36
98	8,440,785	3.53	1866-67	2,490,791	5.78
97	6,949,090	3.30	1865-66	1,785,955	9.34
96	6,815,800	3.68	1864-65	2,422,779	11.46
95	7,191,520	4.28	1863-64	3,261,105	5.36
94	4,884,082	5.26	1862-63	4,069,580	3.36
93	4,633,520	6.64	1861-62	2,893,666	2.42
92	7,761,216	3.91	1860-61	2,155,702	4.57
91	8,173,126	3.54	1859-60	2,350,822	4.73
90	6,663,802	3.66	1858-59	2,465,552	5.02
89	5,483,852	4.99	1857-58	2,210,778	3.69
88	5,921,181	5.04	1856-57	1,818,468	4.75
87	6,439,000	4.19	1855-56	2,489,502	4.60
85-86	6,298,995	3.66	1854-55	2,124,404	3.37
1884-85	6,460,240	4.29	1853-54	2,534,770	3.35
1883-84	5,402,064	5.18	1852-53	2,201,110	4.81
1882-83	6,132,212	6.28	1851-52	1,182,846	3.56
1881-82	5,747,760	6.06	1850-51	1,332,867	3.60
1880-81	6,919,456	4.64	1849-50	1,652,280	2.73
1879-80	6,950,451	4.18	1848-49	1,560,000	3.75
1878-79	7,480,648	2.85	1847-48	1,710,000	2.60
1877-78	6,505,446	3.99	1846-47	825,000	2.85
1876-77	5,101,308	5.74	1845-46	940,000	3.00
1875-76	4,880,135	7.05	1844-45	790,000	2.65
1874-75	5,506,226	6.66	1843-44	1,245,000	
1873-74	5,466,200	4.34	1842-43	675,000	
1872-73	5,410,314	3.73			

TOTAL PACKING IN THE EAST.

The next table gives the statistics for Eastern packing, but these figures do not include the consumption of hogs at New York, Baltimore, and Philadelphia. Returns of hogs packed at these cities are not available, and the number of hogs consumed is approximated by taking the receipts at these places. This gives a fair estimate, as comparatively few hogs are shipped out. It is seen at once that, while there was an almost constant yearly increase in the number of hogs packed in the East from 1882 to 1892, during the last decade (1892–1902) this number has been nearly constant or has shown a slight tendency to decrease. The receipts at the three cities of New York, Baltimore, and Philadelphia, shown in a later table, have a

similar tendency. If there has been the same relative decrease in average weight in the East that has been noted as a feature of the Western situation, which is not unreasonable to suppose, we may infer that pork production has decreased slightly in the East during the last ten years. The table embraces Boston, New Haven, Providence, Worcester, Brightwood, Fall River, Bridgeport, etc., in New England; Buffalo, Albany, Troy, Hudson, etc., in New York; and Pottsville, Harrisburg, Mount Carmel, Allentown, Chester, Coatesville, etc., in Pennsylvania.

Aggregate number of hogs packed in the East during the year ended March 1, for summer and winter seasons and for the year.

[Cincinnati Price Current.]

Year.	Summer.	Winter.	Twelve months.	Year.	Summer.	Winter.	Twelve months.
	Number.	*Number.*	*Number.*		*Number.*	*Number.*	*Number.*
1902-03	1,702,000	1,093,000	2,795,000	1891-92	1,658,409	1,113,754	772,163
1901-02	1,728,000	1,021,000	2,749,000	1890-91	1,473,961	1,036,200	2,540,161
1900-01	1,683,000	1,077,000	2,760,000	1889-90	1,378,520	959,813	2,338,333
1899-00	1,996,000	1,096,000	3,092,000	1888-89	1,231,069	859,494	2,090,563
1898-99	1,895,000	1,269,000	3,164,000	1887-88	1,306,849	951,708	2,258,557
1897-98	1,883,600	1,188,500	3,072,100	1886-87	1,113,410	807,115	1,920,525
1896-97	1,659,800	1,131,100	2,790,900	1885-86	991,448	687,810	1,679,258
1895-96	1,546,500	1,056,000	2,602,500	1884-85	935,238	614,516	1,549,754
1894-95	1,863,000	1,235,500	3,098,500	1883-84	848,153	628,294	1,476,447
1893-94	1,638,205	1,063,029	2,701,234	1882-83	824,081	509,071	1,333,102
1892-93	1,989,720	1,026,310	3,016,030				

VISIBLE MARKETING OF HOGS.

The following compilation shows the comparative visible marketing of hogs for years ended March 1, as indicated by Western and Eastern packing returns and receipts at New York, Philadelphia, and Baltimore:

Visible marketing of hogs, 1879–1903.

[Cincinnati Price Current.]

Year.	Western packing.	Eastern packing.	Receipts at 3 cities.	Total.
	Number.	*Number.*	*Number.*	*Number.*
1879-80	11,002,000	1,154,000	2,673,000	14,829,000
1880-81	12,243,000	1,209,000	2,701,000	16,153,000
1881-82	10,551,000	1,005,000	2,915,000	14,471,000
1882-83	9,343,000	1,333,000	2,450,000	13,126,000
1883-84	9,183,000	1,476,000	2,594,000	13,253,000
1884-85	10,519,000	1,550,000	2,658,000	14,727,000
1885-86	11,264,000	1,679,000	2,883,000	15,826,000
1886-87	12,083,000	1,995,000	2,905,000	16,983,000
1887-88	11,533,000	2,258,000	2,599,000	16,390,000
1888-89	10,799,000	2,091,000	2,760,000	15,650,000
1889-90	13,545,000	2,338,000	3,023,000	18,906,000

Visible marketing of hogs, 1879–1903—Continued.

Year.	Western packing.	Eastern packing.	Receipts at 3 cities.	Total.
	Number.	*Number.*	*Number.*	*Number.*
1890–91	17,713,000	2,540,000	3,713,000	[illegible]
1891–92	14,457,000	2,771,000	3,684,000	[illegible]
1892–93	12,390,000	3,016,000	2,790,000	[illegible]
1893–94	11,605,000	2,701,000	2,483,000	[illegible]
1894–95	16,003,000	3,099,000	2,517,000	[illegible]
1895–96	15,010,000	2,603,000	2,867,000	[illegible]
1896–97	16,929,000	2,791,000	2,950,000	[illegible]
1897–98	20,201,000	3,072,000	2,861,000	[illegible]
1898–99	23,651,000	3,164,000	2,978,000	[illegible]
1899–00	22,201,000	3,092,000	2,879,000	[illegible]
1900–01	23,600,000	2,760,000	2,620,000	[illegible]
1901–02	25,411,000	2,749,000	2,235,000	[illegible]
1902–03	20,605,000	2,795,000	1,840,000	[illegible]

Commenting on these figures, the Price Current calls attention to the fact that it is difficult to estimate satisfactorily the number of hogs slaughtered in the country—on farms, etc.—which are not included in the above figures, but it is likely this number has been 10,000,000 or more each year in late years, bringing the aggregate slaughtering up to approximately 40,000,000 for the entire country in years of larger operations, in periods of most plentiful supplies.

LARD PRODUCTION COMPARISONS.

The total lard production of western packing for years ended March 1, and also for the packing at eastern cities, and from hogs slaughtered at New York, Baltimore, and Philadelphia, are shown in the following:

Production of lard, 1880–1903.

[Cincinnati Price Current.]

Year.	Western packing.	Other production.	Total.	Year.	Western packing.	Other production.	Total.
	Pounds.	*Pounds.*	*Pounds.*		*Pounds.*	*Pounds.*	*Pounds.*
1880–81	409,875,000	107,785,000	517,660,000	1892–93	388,985,000	145,000,000	[illegible]
1881–82	363,772,000	105,157,000	468,929,000	1893–94	409,052,000	130,000,000	[illegible]
1882–83	316,063,000	103,450,000	419,513,000	1894–95	533,055,000	140,000,000	[illegible]
1883–84	318,472,000	125,978,000	444,450,000	1895–96	513,467,000	136,000,000	[illegible]
1884–85	364,376,000	116,029,000	480,405,000	1896–97	662,040,000	143,500,000	[illegible]
1885–86	390,741,000	123,489,000	514,230,000	1897–98	721,354,000	148,000,000	[illegible]
1886–87	394,118,000	132,914,000	527,032,000	1898–99	808,473,000	153,000,000	[illegible]
1887–88	357,755,000	129,424,000	487,179,000	1899–00	794,453,000	150,000,000	[illegible]
1888–89	359,927,000	123,975,000	483,902,000	1900–01	805,703,000	135,000,000	[illegible]
1889–90	489,727,000	134,500,000	624,227,000	1901–02	803,129,000	125,000,000	[illegible]
1890–91	618,732,000	156,300,000	775,032,000	1902–03	650,707,000	115,000,000	[illegible]
1891–92	479,000,000	163,000,000	642,000,000				

THE FOREIGN TRADE.

EXPORTS OF HOGS AND HOG PRODUCTS.

The following figures show the export trade in hogs and hog products, by countries, for the past three fiscal years ended June 30. The most striking feature of our foreign trade is the almost complete predominance of exports. This is so great that, except for bristles, the imports have not received separate enumeration by the Treasury Department. The balance of trade in bristles is still in favor of foreign countries:

Exports of hogs and hog products during three years, 1901–1903.

[Bureau of Statistics, Treasury Department.]

Article and country of import.	1901.		1902.		1903.	
	Quantities.	Values.	Quantities.	Values.	Quantities.	Values.
Hogs exported to—	*Number.*	*Dollars.*	*Number.*	*Dollars.*	*Number.*	*Dollars.*
British North America	1,427	12,886	2,352	17,535	1,318	11,608
Mexico	2,904	32,709	2,002	25,939	1,191	11,470
West Indies and Bermuda	17,920	191,772	3,951	43,779	1,223	15,295
South America	14	255	33	885	.....	.....
Asia and Oceania	6	250	.....	.....	17	366
Other countries	47	598	80	192	282	2,184
Total	22,318	238,465	8,368	88,330	4,031	40,923
	Gallons.		*Gallons.*		*Gallons.*	
Lard oil	766,783	438,645	460,095	327,794	356,658	306,334
Bacon exported to—	*Pounds.*		*Pounds.*		*Pounds.*	
United Kingdom	369,082,490	30,884,512	310,380,798	28,927,610	162,549,709	17,572,088
Belgium[a]	.....	.....	21,361,704	1,941,997	11,349,214	1,131,406
France	2,755,224	196,782	845,484	75,048	447,546	44,796
Germany	18,394,890	1,396,055	20,009,656	1,675,155	13,705,305	1,339,119
Netherlands[a]	.....	.....	5,736,628	499,230	3,764,141	385,211
Other Europe	51,340,500	3,758,615	38,208,232	3,303,449	4,761,205	479,095
British North America	4,524,858	435,964	5,778,081	621,958	4,179,619	474,302
Central American States and British Honduras	323,465	29,608	319,766	29,888	250,919	26,795
Mexico	303,728	32,733	291,747	32,890	241,699	32,775
Santo Domingo	21,049	1,944	13,062	1,302	.....	.....
Cuba	5,687,413	456,456	4,111,136	364,536	3,346,240	345,233
Porto Rico[b]	.....	.....	.....	.....	.....	.....
Other West Indies and Bermuda	380,530	39,086	367,206	41,747	357,117	49,033
Brazil	2,456,927	191,186	1,908,467	181,708	1,774,305	213,199
Colombia	19,331	1,776	23,271	2,204	28,066	3,181
Other South America	311,350	27,357	319,153	33,368	154,991	17,773
Chinese Empire	170,487	23,400	118,158	17,976	95,157	16,233
Hawaii[b]	.....	.....	.....	.....	.....	.....

[a] Included in "Other Europe" prior to 1902.

[b] The commerce between the United States and Hawaii and Porto Rico, respectively, is not included in the statements of the foreign trade of the United States after June 30, 1900, but after this date the trade of Hawaii, and after July 1, 1901, of Porto Rico, with foreign countries is included in the statement of the domestic commerce of the United States.

Exports of hogs and hog products during three years, 1901–1903—Continued.

Article and country of import.	1901.		1902.		1903.	
	Quantities.	Values.	Quantities.	Values.	Quantities.	Values.
aon exported to—Con.	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*
Philippine Islands	1,015	152	79,022	9,922	37,918	6,257
Other Asia and Oceania	117,552	15,662	109,575	16,708	182,082	30,508
Africa	223,432	17,738	267,865	24,328	110,767	11,571
Total	456,122,741	37,499,026	383,150,624	35,449,797	207,396,000	22,178,525
is exported to—						
Jnited Kingdom	191,127,894	20,269,042	202,390,263	22,569,633	189,026,769	22,797,381
;ium[a]			6,648,096	674,814	3,814,913	411,308
ıce	667,119	65,310	180,041	18,572	135,740	14,863
Germany	2,156,646	218,758	2,128,576	219,826	1,143,210	116,656
Netherlands[a]			2,271,815	233,515	1,506,088	158,022
Other Europe	8,990,373	883,689	9,820,647	1,003,123	2,128,325	243,561
British North America	2,770,198	302,793	3,480,795	375,436	7,720,075	896,608
Central American States and British Honduras	324,484	34,603	273,098	31,088	228,239	29,491
Mexico	422,185	49,628	476,172	58,690	488,523	64,699
Santo Domingo	103,412	13,397	88,513	11,809		
Cuba	6,261,019	595,776	5,576,814	554,590	4,719,571	542,695
Porto Rico[b]						
Other West Indies and Bermuda	1,923,525	190,428	1,672,575	184,677	1,565,887	205,782
Brazil	50,518	5,921	29,171	3,269	17,854	2,286
Colombia	179,069	18,023	152,210	16,164	116,630	14,561
Other South America	682,310	83,510	599,733	77,154	626,771	82,347
Chinese Empire	200,556	34,671	166,615	24,137	220,297	34,225
British Australasia	83,684	8,173	2,787	272	33,934	4,207
Hawaii[b]						
Philippine Islands	68,212	8,756	201,264	24,475	100,562	13,495
Other Asia and Oceania	275,011	36,791	212,216	28,464	251,814	37,206
Africa	197,280	20,798	181,433	18,956	314,943	39,657
Other countries	27,713	2,711	20,309	2,409	23,220	3,061
Total	216,571,803	22,842,778	227,653,232	25,222,744	214,183,365	25,712,639
ork:						
Canned	8,945,594	708,381	9,603,882	832,910	13,590,897	1,302,687
Fresh	30,728,586	2,424,537	44,171,674	3,652,464	20,906,113	2,035,491
Salted or pickled	138,643,611	9,926,633	115,896,275	10,117,562	95,287,374	9,959,762
Total fresh and salted	169,372,197	12,351,170	160,067,949	13,770,026	116,253,487	11,995,253
Exported to—						
United Kingdom	88,731,438	6,830,647	98,504,537	8,641,863	71,497,640	7,592,301
Belgium[a]			6,047,148	520,219	3,915,839	402,417
France	111,925	7,196	78,000	6,750	89,300	8,851
Germany	9,830,423	655,697	8,671,775	719,438	2,896,130	270,437
Netherlands[a]			8,277,773	714,704	2,767,981	284,635
Other Europe	30,451,098	2,096,818	21,834,445	1,860,467	6,651,407	667,269
British North America	10,241,105	668,047	9,935,122	754,852	9,698,429	917,802

[a] Included in "Other Europe" prior to 1902.

[b] See note b, page 259.

Exports of hogs and hog products during three years, 1901–1903—Continued.

Article and country of import.	1901.		1902.		1903.	
	Quantities.	Values.	Quantities.	Values.	Quantities.	Values.
Pork—Continued.	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*
Exported to—						
Central American States and British Honduras	1,532,495	107,511	1,319,601	107,536	1,407,465	131,543
Santo Domingo	135,490	10,042	110,842	9,594	.....	.....
Cuba	7,902,577	587,849	5,734,050	491,486	2,902,606	270,016
Porto Rico[a]	.....	.....	.....	.....	.....	.....
Other West Indies and Bermuda	15,634,141	1,047,020	10,069,824	853,084	8,151,649	806,051
Brazil	3,800	262	19,600	1,900	188,050	19,255
Colombia	229,332	17,292	194,762	16,588	129,060	12,386
Other South America	4,006,308	281,899	3,278,446	278,115	3,097,524	301,266
Philippine Islands	.....	.....	9,800	950	17,913	2,045
Other Asia and Oceania	96,635	7,768	76,035	6,600	1,223,622	122,785
Africa	166,300	11,675	119,800	10,365	1,528,055	176,737
Other countries	299,130	21,447	111,310	10,438	90,826	9,479
Total	169,372,197	12,351,170	160,067,949	13,770,026	116,253,487	11,995,253
Lard exported to—						
United Kingdom	211,264,628	16,377,255	199,442,907	19,019,841	196,458,773	20,747,232
Belgium[b]	.....	.....	30,404,880	2,874,757	23,702,251	2,413,561
France	15,471,922	1,148,518	7,801,007	691,981	4,346,321	427,708
Germany	182,389,879	13,700,875	173,269,658	16,237,434	148,962,391	15,448,598
Italy[a]	.....	.....	2,348,733	222,845	3,375,019	351,265
Netherlands[a]	.....	.....	53,269,049	5,060,486	42,002,215	4,470,418
Other Europe	112,222,710	8,434,928	108,040,377	10,147,575	18,925,350	1,900,150
British North America	3,321,798	270,609	1,737,936	175,156	1,389,844	141,840
Central American States and British Honduras	2,551,001	203,598	1,756,920	170,670	1,487,472	144,779
Mexico	6,937,766	454,040	8,098,615	702,082	3,448,455	320,691
Santo Domingo	506,279	40,571	471,934	46,355	.....	.....
Cuba	38,304,327	2,811,696	25,374,052	2,144,229	20,379,728	1,812,639
Porto Rico[b]	.....	.....	.....	.....	.....	.....
Other West Indies and Bermuda	6,749,150	529,887	5,904,362	543,697	7,281,986	676,513
Argentina	107,893	9,218	68,195	7,028	40,471	4,414
Brazil	12,938,329	1,124,619	10,194,268	1,059,556	6,018,988	688,236
Chile[c]	.....	.....	413,285	45,868	546,222	60,197
Colombia	1,480,890	115,264	1,145,374	98,995	1,910,567	176,260
Venezuela[c]	.....	.....	4,014,964	418,767	2,467,088	243,675
Other South America	12,703,416	1,001,679	9,058,826	890,548	4,056,847	385,777
Hawaii[b]	.....	.....	.....	.....	.....	.....
Philippine Islands	77,255	6,975	211,821	19,700	135,471	14,761
Other Asia and Oceania	2,103,855	148,827	744,073	67,541	1,094,727	114,506
Africa	2,155,971	176,812	3,465,662	348,519	2,696,205	308,080
Other countries	70,445	4,777	54,235	4,957	29,430	3,204
Total	611,357,514	46,560,148	556,840,222	52,375,864	490,755,821	50,854,504

[a] Included in "Other Europe" prior to 1902.
[b] Omitted as part of foreign traffic of United States after June 30, 1900.
[c] Included in "Other South America" prior to 1902.

The export trade in live hogs is not an important factor of the industry, and the tendency on the part of dealers to ignore it is evident, especially when these figures are compared with those in the next table, which show exports since 1790. The greater proportion of live hogs exported go to the West Indies and Bermuda, Mexico, and British America.

The quantities of lard oil exported during the fiscal year ended June 30, 1903, were considerably less than those of 1902, and decidedly so as compared with 1901.

In exports of hog products bacon first commands our attention. It is noteworthy that there has been a very large decrease in the quantities exported during the last three years, but there is not the same decrease in total values; indeed, the latter have remained practically stationary. This is due, of course, to the rapid rise in domestic prices, which has also had much to do with the falling off in the foreign demand.

In all kinds of meat products of hogs the United Kingdom is our best customer. In bacon Germany stands second, but during the period under consideration Great Britain and Ireland purchased from twelve to twenty times as much bacon as Germany. Since being separately reported, Belgium shows purchases of bacon fully as large as those of Germany.

Hams show an increase from 196,414,412 pounds in 1900, valued at $20,416,367, to 227,653,232 pounds in 1902, valued at $25,222,744, but a decrease to 214,183,365 pounds in 1903, valued at $25,712,633. The purchases of United States hams by the United Kingdom form about 85 per cent of our total export trade in this product.

Pork exports have also decreased during the past three years. While the United Kingdom purchases a greater percentage of our hams and bacon than she does of our fresh pork, she takes more than half our exports of this product—continental Europe, the West Indies and Bermuda, and British America figuring rather prominently among the other purchasers.

Lard has also fallen in foreign demand. The United States sells the United Kingdom practically all the lard she imports, other countries also purchasing immense quantities. The United Kingdom takes about one-third the total amount, Germany following closely, and very large amounts go to other European countries.

The following table shows the total exports of hogs and hog products since and including the year 1790:

Total exports of hogs, hams and bacon, pork, and lard from the United States.[a]

Fiscal year.[b]	Live hogs.		Hams and bacon.		Pork.		Lard.	
	Number.	Value.	Pounds.	Value.	Barrels.	Value.	Pounds.	Value.
		Dollars.		*Dollars.*		*Dollars.*		*Dollars.*
1790	5,304	14,481	253,555	19,728	24,462	208,099	355,880	31,475
1791	16,803	45,368	295,647	26,590	[c]26,635	266,350	522,715	41,817
1792	21,291	.....	585,353	.....	[d]38,098	.....	515,245	.....
1793	9,901	.....	521,483	.....	38,563	.....	596,397	.....
1794	5,705	.....	1,147,262	.....	49,453	.....	1,100,780	.....
1795	4,922	.....	1,778,564	.....	88,193	.....	1,490,554	.....
1796	6,753	.....	2,096,877	.....	73,881	.....	1,124,971	.....
1797	3,484	.....	1,084,008	.....	40,125	.....	731,511	.....
1798	4,237	.....	1,105,584	.....	33,115	.....	876,773	.....
1799	3,786	.....	1,412,005	.....	52,268	.....	1,451,657	.....
1800	14,294	.....	1,178,244	.....	55,467	.....	1,633,562	.....
1801	7,312	.....	2,034,630	.....	70,779	.....	2,376,500	.....
1802	5,501	.....	1,588,267	.....	78,239	.....	1,958,400	.....
1803	6,859	.....	1,686,546	.....	96,602	.....	2,052,302	.....
1804	5,599	.....	1,904,284	.....	111,532	.....	2,565,719	.....
1805	2,808	.....	903,924	.....	57,925	.....	1,308,287	.....
1806	1,747	.....	1,347,018	.....	36,277	.....	1,542,500	.....
1807	1,831	.....	1,311,246	.....	39,274	.....	1,815,998	.....
1808	1,956	.....	258,418	.....	15,478	.....	585,173	.....
1809	537	.....	1,082,610	.....	42,652	.....	1,371,089	.....
1810	250	.....	1,218,855	.....	37,209	.....	1,365,333	.....
1811	4,454	.....	1,286,809	.....	37,270	.....	1,927,451	.....
1812	2,380	.....	729,398	.....	22,746	.....	1,616,417	.....
1813	485	.....	607,196	.....	17,337	.....	1,084,565	.....
1814	160	.....	138,556	.....	4,040	.....	513,928	.....
1815	757	.....	695,357	.....	9,073	.....	1,045,633	.....
1816	1,988	.....	530,129	.....	19,280	.....	1,088,348	.....
1817	1,103	5,515	341,419	61,455	14,462	303,702	926,018	166,683
1818	524	2,882	602,274	102,387	17,553	403,719	1,363,663	245,459
1819	2,324	13,944	700,369	105,055	28,173	563,460	2,178,076	326,711
1820	3,627	36,270	1,005,462	120,655	44,091	705,456	2,636,636	316,396
1821	7,885	.....	1,607,506	.....	66,647	.....	3,996,561	.....
1822	9,798	.....	1,142,945	.....	68,352	.....	4,137,814	.....
1823	11,436	.....	1,637,157	.....	55,529	.....	6,067,071	.....
1824	8,838	.....	1,400,199	.....	67,229	.....	5,053,182	.....
1825	4,525	.....	1,896,359	.....	85,709	.....	5,483,048	.....
1826	6,939	.....	1,836,133	.....	88,994	.....	7,231,643	.....
1827	18,441	.....	1,864,956	.....	73,813	.....	6,927,084	.....
1828	16,171	.....	1,837,920	.....	53,836	.....	7,493,319	.....
1829	10,779	.....	2,305,405	.....	59,539	.....	7,154,742	.....
1830	22,294	.....	2,154,986	.....	45,645	.....	6,001,417	.....
1831	14,690	.....	1,477,446	.....	51,263	.....	6,963,516	.....
1832	5,266	.....	1,810,830	.....	88,625	.....	7,756,782	.....
1833	6,819	.....	1,786,637	.....	105,870	.....	7,655,198	.....
1834	3,338	.....	1,530,628	.....	82,691	.....	9,050,342	.....
1835	3,980	.....	1,432,027	.....	61,827	.....	10,637,490	.....
1836	1,231	.....	1,398,475	.....	22,550	.....	6,493,878	.....

[a] Domestic and foreign exports were not separated until 1803; from this date the figures are for domestic exports only.

[b] The fiscal year ended September 30 up to and including 1842; thereafter June 30.

[c] Not including 29,334 pounds "fresh pork," valued at $1,760.

[d] Not including 3,008 pounds "fresh pork."

Total exports of hogs, hams and bacon, pork, and lard, etc.—Continued.

Fiscal year.	Live hogs.		Hams and bacon.		Pork.		Lard.	
	Number.	Value.	Pounds.	Value.	Barrels.	Value.	Pounds.	Value.
		Dollars.		*Dollars.*		*Dollars.*		*Dollars.*
1837	1,110	.....	965,935	.....	24,583	.....	6,388,174	.....
1838	366	.....	1,194,890	.....	31,356	.....	7,209,478	.....
1839	772	.....	1,445,527	.....	41,301	.....	7,723,834	.....
1840	4,854	.....	1,643,397	.....	66,281	.....	7,418,847	.....
1841	7,901	.....	2,794,517	.....	133,290	.....	10,597,654	.....
1842	5,564	.....	2,518,841	.....	180,032	.....	20,102,397	.....
1843[a]	7,162	.....	2,422,067	.....	80,310	.....	24,534,217	.....
1844	9,615	.....	3,886,976	.....	161,629	.....	25,746,355	.....
1845	6,384	.....	2,719,363	.....	161,609	.....	20,060,993	.....
1846	7,437	.....	3,006,630	.....	190,422	.....	21,843,164	.....
1847	3,274	(b)	17,921,471	.....	206,190	.....	37,611,161	.....
1848	4,750	(b)	33,551,034	.....	218,259	.....	49,625,520	.....
1849	1,121	(b)	56,060,822	.....	253,486	.....	37,446,761	.....
1850	881	(b)	41,014,528	.....	188,841	.....	54,925,546	.....
1851	1,030	(b)	18,027,302	.....	165,201	.....	19,683,082	.....
1852	185	(b)	5,746,016	.....	83,382	.....	21,281,951	.....
1853	22	(b)	18,390,027	.....	129,881	.....	24,435,014	.....
1854	279	(b)	45,953,473	.....	220,147	.....	44,450,154	.....
1855	431	2,192	38,188,989	3,195,978	298,760	4,390,979	39,025,492	4,688,0[illegible]
1856	1,391	6,331	41,748,092	3,863,328	281,395	5,029,940	37,582,271	3,870,9[illegible]
1857	923	5,525	43,863,539	4,511,442	144,513	2,805,867	40,246,544	5,144,19[illegible]
1858	96,000	810,406	20,954,374	1,957,423	159,874	2,852,942	31,022,286	3,839,5[illegible]
1859	95,509	550,875	11,989,694	1,263,042	205,742	3,355,746	28,362,706	3,268,40[illegible]
1860	48,355	377,664	25,844,610	2,273,768	204,743	3,132,313	40,289,519	4,545,8[illegible]
1861	463	3,207	50,264,287	4,848,339	156,487	2,609,818	47,908,911	4,729,29[illegible]
1862	3,306	23,562	141,212,786	10,290,572	309,102	3,980,153	118,573,307	10,004,32[illegible]
1863	9,467	96,363	218,243,609	18,658,280	327,851	4,334,775	155,336,596	15,755,57[illegible]
1864	9,199	86,907	110,886,446	12,323,327	315,597	5,828,030	97,190,765	11,289,72[illegible]
1865	1,400	12,771	46,053,034	10,536,608	208,934	6,850,808	44,480,136	9,134,85[illegible]
					Pounds.			
1866	951	15,454	37,588,930	6,269,796	30,056,788	4,788,484	30,110,451	5,979,65[illegible]
1867	3,577	40,092	25,648,226	3,291,176	27,374,877	3,597,690	45,608,031	6,634,55[illegible]
1868	1,399	18,447	43,659,004	5,476,998	28,690,133	3,267,652	64,555,462	9,427,8[illegible]
1869	(b)	.....	49,228,165	7,482,060	24,439,832	3,422,928	41,887,545	7,443,94[illegible]
1870	12,058	189,753	38,968,256	6,123,113	24,639,831	3,253,137	35,808,530	5,963,36[illegible]
1871	8,770	61,390	71,446,854	8,126,683	39,250,750	4,302,320	80,037,297	10,563,09[illegible]
1872	56,110	548,153	246,208,143	21,126,592	57,169,518	4,122,308	190,651,990	20,177,61[illegible]
1873	99,720	787,402	395,381,737	35,022,137	64,147,461	5,007,035	230,534,207	21,245,61[illegible]
1874	158,581	1,625,837	347,405,405	33,383,908	70,482,379	5,808,712	205,527,471	19,308,03[illegible]
1875	64,979	739,215	250,286,549	28,612,613	56,152,331	5,671,495	166,869,383	22,900,52[illegible]
1876	68,044	670,042	327,730,172	39,664,456	54,195,118	5,744,022	168,405,839	22,429,46[illegible]
1877	65,107	699,180	460,057,140	49,512,412	69,671,894	6,296,414	234,741,233	25,562,66[illegible]
1878	29,284	267,259	592,814,351	51,752,068	71,889,255	4,913,657	342,706,254	30,022,13[illegible]
1879	75,129	700,262	732,249,576	51,074,433	84,401,676	4,807,568	336,658,686	22,856,67[illegible]
1880	83,434	421,089	759,773,109	50,987,623	95,949,780	5,930,252	374,979,286	27,929,36[illegible]
1881	77,456	572,138	746,944,545	61,161,205	107,928,086	8,272,285	378,142,496	35,226,53[illegible]
1882	26,368	509,651	468,026,640	46,675,774	80,447,466	7,201,270	250,367,740	28,975,90[illegible]
1883	16,129	272,516	340,258,670	38,155,952	62,116,302	6,192,268	224,718,474	26,618,04[illegible]
1884	46,382	627,480	389,499,368	39,684,845	60,548,730	4,762,715	265,094,719	25,305,95[illegible]
1885	55,025	579,183	400,127,119	37,083,948	72,073,468	5,233,943	283,216,339	22,305,27[illegible]
1886	74,187	674,297	419,788,796	31,640,211	87,267,715	5,123,411	263,728,019	20,361,78[illegible]

[a] For nine months only owing to change in fiscal year.

[b] None specified separately.

Total exports of hogs, hams and bacon, pork, and lard, etc.—Continued.

Fiscal year.	Live hogs.		Hams and bacon.		Pork.		Lard.	
	Number.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
		Dollars.		*Dollars.*		*Dollars.*		*Dollars.*
1887	75,383	564,753	419,922,955	33,314,670	85,893,297	5,641,327	321,533,746	22,703,921
1888	23,755	193,017	375,439,683	32,175,633	58,900,153	4,373,114	297,740,007	22,751,105
1889	45,128	356,764	400,224,646	34,651,847	64,133,639	4,735,077	318,242,990	27,329,173
1890	91,148	909,042	608,490,956	47,056,760	80,068,331	4,768,894	471,083,598	33,455,520
1891	95,654	1,146,630	599,085,665	45,650,674	82,136,239	4,843,701	498,343,927	34,414,323
1892	31,963	364,081	584,776,389	47,092,650	80,714,227	4,822,295	490,045,776	33,201,021
1893	27,375	397,162	473,936,329	45,714,566	53,372,366	4,196,263	365,693,501	34,643,993
1894	1,553	14,753	503,628,148	48,183,905	64,744,528	5,159,868	447,566,867	40,089,809
1895	7,130	72,424	558,044,099	48,736,860	59,085,474	4,199,060	474,895,274	36,821,508
1896	21,049	227,297	554,388,538	46,112,610	70,243,029	4,017,200	509,534,256	33,589,851
1897	28,751	295,998	665,646,750	50,157,168	68,075,344	3,392,030	568,315,640	29,126,485
1898	14,411	110,487	850,294,794	65,368,443	100,357,363	5,722,096	709,344,045	39,710,672
1899	33,031	227,241	788,498,230	62,331,151	178,507,564	10,659,727	711,259,851	42,208,465
1900	51,180	394,813	708,568,141	59,392,282	167,642,662	10,827,971	661,813,663	41,939,164
1901	22,318	238,465	672,694,544	60,341,804	178,317,791	13,059,551	611,357,514	46,530,148
1902	8,368	88,380	610,803,856	60,672,541	169,671,831	14,602,936	556,840,222	52,375,864
1903	4,031	40,923	421,519,865	47,891,158	116,253,487	11,995,253	490,755,821	50,854,504

Exports of lard oil and bristles, 1855 to 1903.

Fiscal year.	Lard oil.		Bristles.		Fiscal year.	Lard oil.		Bristles.	
	Gallons.	Value.	Pounds.	Value.		Gallons.	Value.	Pounds.	Value.
1855	103,200	$82,945	.....	.....	1880	1,507,596	$816,447	[b] 97,505	$22,742
1856	212,262	161,232	.....	.....	1881	836,255	558,576	29,707	8,722
1857	91,432	92,499	.....	.....	1882	506,259	434,124	32,965	10,005
1858	68,342	60,958	.....	.....	1883	379,205	353,184	83,047	10,053
1859	56,675	50,793	.....	.....	1884	712,696	504,218	73,287	20,852
1860	60,209	55,783	.....	.....	1885	916,157	555,426	.....	.....
1861	85,676	81,783	.....	.....	1886	973,229	500,011	.....	.....
1862	239,608	148,056	.....	.....	1887	975,163	519,274	.....	.....
1863	1,259,063	983,349	.....	.....	1888	930,616	509,514	.....	.....
1864	440,546	377,994	.....	.....	1889	861,303	542,897	.....	.....
1865	100,520	157,671	.....	.....	1890	1,214,611	663,343	.....	.....
1866	42,358	70,360	.....	.....	1891	1,092,448	562,986	.....	.....
1867	144,158	176,363	.....	.....	1892	907,575	496,601	.....	.....
1868	279,432	330,179	.....	.....	1893	486,812	336,613	.....	.....
1869	.....	97,370	.....	$3,000	1894	681,081	449,571	.....	1,844
1870	90,774	124,860	.....	176	1895	553,421	304,093	.....	.....
1871	147,802	153,850	.....	275	1896	833,935	426,401	.....	.....
1872	538,147	432,483	.....	.....	1897	961,407	419,803	.....	.....
1873	388,836	298,731	.....	3,150	1898	775,102	305,825	.....	.....
1874	252,577	203,317	.....	14,210	1899	917,007	412,447	.....	.....
1875	146,594	147,384	.....	640	1900	738,724	337,260	.....	.....
1876	146,323	149,156	.....	10,460	1901	766,783	438,645	.....	.....
1877	247,305	281,551	.....	22,770	1902	460,035	327,794	.....	.....
1878	1,553,314	986,561	[a] 60,267	17,600	1903	356,658	306,384	.....	.....
1879	1,963,208	1,097,923	80,140	22,350					

[a] Quantity from Baltimore only; the value includes $10 worth from other ports.
[b] Quantity from Baltimore only; the value includes $245 worth from other ports.

The foregoing tables show clearly the gro
in hogs and hog products. There is a tende
trade in live hogs. In the early years of t
larger number of live hogs were often shi
than during the fiscal year ended June 3
importance of these shipments—such, for e
14,294 in 1800, and 22,294 in 1830—undoul
greater proportion of the hog output in thos
or 51,180 in 1900. The least number export
one year, 1869, when live hogs were not s
greatest number exported was in 1874, wh
abroad. Since 1870 there has been more u
of the trade than before that date. Excep
1902, and 1903, the number exported has n
and, except in 1874, it has never exceeded 1

Hams and bacon were included in the s
reports, and, for sake of uniformity, this
this table. From the earliest times hams
prominently in our export trade. From 17
specially marked tendency to growth, bu
tenance of trade. The foreign trade con
2,000,000 pounds annually, occasionally goin
ing these figures, dropping to 138,556 pou
second war with Great Britain, when the f
of hog products was affected, and reaching
The real growth of our export trade in han
the fiscal year ended June 30, 1847. Fro
pounds in 1846 the foreign trade consumed n
1847, and, except in 1852, when these prod
pounds, no year shows sales so small as
rapid development characterizes the foreign
ucts and has two very well-marked period
1871, the second from 1872 to the present
period exports of hams and bacon exceeded
during three years of the Civil War per
period, when artificial refrigeration has pl
in the commerce in meats, the trade has
growth, starting with 246,208,143 pounds,
1872, and reaching 850,294,794 pounds, valu

Pork shows a greater growth prior to 18
There is the same period of depression due t
merce during the war of 1812–1815, and aft
siderable foreign trade. From 1847 to 1871 g
decrease being apparent in 1852 and the same
After 1872 the lowest amount exported was
at $4,196,263, in 1893; the greatest amount
1899, valued at $10,639,727, and the great
169,671,831 pounds, valued at $14,602,936.

Prior to 1847 lard shows more growth than the other hog products. It was also least affected by the war of 1812–1815. In the year 1847 the same increase may be noticed and the same depression in the early fifties. There is also the same increase during the civil war. From 1871 to 1872 lard shows an increase of 150 per cent in the foreign trade, as compared with an increase of more than 240 per cent in that of hams and bacon and over 45 per cent in that of pork. From a foreign consumption of 199,651,660 pounds in 1872, valued at $20,177,619, the lard exports reached their maximum quantity in 1899, with 711,259,851 pounds, valued at $42,208,465, and their maximum value in 1902, with 556,840,222 pounds, valued at $52,375,864.

Lard oil does not figure in the exports until 1855, when 103,200 gallons, valued at $82,945, were exported. The rapid development of the early seventies is also seen in the exports of this product. The greatest amount was shipped in 1879—1,963,208 gallons, valued at $1,037,923, which was also the greatest value for any year.

Averages of five-year periods.—The following table shows the average annual exports of hog products from 1873 to 1902, inclusive, arranged in five-year periods:

Exports of hog products from the United States, average of five-year periods, 1873 to 1902.

Fiscal years.	Hams and bacon.		Pork.	
	Quantity.	Value.	Quantity.	Value.
	Pounds.	*Dollars.*	*Pounds.*	*Dollars.*
1873–1877	356,172,201	37,239,105	62,929,837	5,705,536
1878–1882	659,961,644	52,330,221	88,123,253	6,225,006
1883–1887	393,919,382	35,975,925	73,579,902	5,384,733
1888–1892	513,603,468	41,325,513	73,190,518	4,708,616
1893–1897	551,128,773	47,781,022	63,104,148	4,192,884
1898–1902	726,171,913	61,021,244	158,899,442	10,970,444

Fiscal years.	Lard.		Lard oil.	
	Quantity.	Value.	Quantity.	Value.
	Pounds.	*Dollars.*	*Gallons.*	*Dollars.*
1873–1877	201,215,629	22,289,301	256,327	216,028
1878–1882	334,582,892	29,000,330	1,273,326	766,726
1883–1887	277,658,259	23,516,985	791,290	486,423
1888–1892	409,091,260	30,230,348	1,001,311	555,068
1893–1897	473,201,108	34,854,329	703,331	387,296
1898–1902	650,123,059	44,558,803	731,530	364,394

These figures bring out much more clearly the rapid growth of our foreign trade. The annual amount of hams and bacon, pork, and lard oil exported have more than doubled since the five-year period of 1873–1877, while the lard exports have more than tripled in this time.

IMPORTS OF HOGS AND HOG PRODUCTS.

The following table shows the total imports of hogs and hog products into the United States since and including the year 1824:

Imports of hams and bacon, pork, and lard into the United States.

Fiscal year.[a]	Hams and bacon.[b]		Pork.[c]		Lard.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*
1824	6,272	422	279	19	.....	.....
1825	15,626	1,244	263,694	5,294	.....	.....
1826	43,525	3,679	736,156	22,962	.....	.....
1827	5,214	503	206,881	8,049	262	42
1828	3,804	343	461,143	22,094	1,648	88
1829	9,526	1,073	430,186	17,598	147	18
1830	7,617	651	659,099	28,220	135	18
1831	27,757	2,506	395,962	6,660	5,778	451
1832	24,305	2,204	90,887	2,115	728	41
1833	14,851	1,651	379,270	11,748	1,051	99
1834	29,950	3,189	1,196,009	37,102	.....	.....
1835	65,625	5,739	.....	.....	.....	.....
1836	173,945	16,944	75,311	4,286	210,073	27,011
1837	219,694	22,013	158,639	11,654	52,372	5,239
1838	215,208	20,939	990,766	28,570	80	9
1839	316,492	32,539	777,551	28,734	13,375	1,437
1840	122,451	14,037	467,916	12,429	98	7
1841	120,378	13,420	158,174	3,639	80	5
1842	59,384	6,222	186,973	3,154	40	3
1843[d]	26,815	2,731	359,801	5,984	.....	.....
1844	26,499	3,222	259,379	6,312	47	3
1845	30,968	3,540	27,866	1,088	.....	.....
1846	36,936	4,276	11,639	776	1,524	121
1847	21,356	2,880	29,364	1,908	350	17
1848	18,135	2,769	43,530	2,688	8,100	715
1849	23,188	2,268	25,184	1,515	249	14
1850	105,059	9,381	241,883	7,508	48	2
1851	136,273	13,456	41,276	1,667	2,672	131
1852	177,169	13,358	646,722	31,778	61,068	5,267
1853	81,149	7,455	748,300	26,766	16,130	946
1854	68,691	8,419	212,040	12,723	150,868	19,728
1855	75,216	9,411	158,397	6,194	104,068	9,329
1856	68,405	9,551	7,054	622	4,568	498
1857	48,263	7,204	36,323	2,614	362,931	28,046
1858	70,948	9,054	11,956	595	67,666	8,046
1859	85,623	12,197	12,348	1,340	12,165	1,373
1860	118,904	16,020	15,288	841	23,201	2,431
1861	77,639	11,055	2,548	151	199,754	9,627
1862	52,770	5,866	.....	.....	[e]271,529	21,239

[a] The fiscal year ended September 30, up to and including 1842; thereafter, June 30.
[b] From 1828 to 1842, inclusive, bacon only reported.
[c] Includes beef from 1824 to 1857 and from 1865 to 1871.
[d] For nine months only, owing to change of fiscal year.
[e] Includes tallow.

orts of hams and bacon, pork, and lard into the United States—Continued.

Fiscal year.	Hams and bacon.		Pork.		Lard.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.	*Dollars.*	*Pounds.*	*Dollars.*	*Pounds.*	*Dollars.*
	51,421	7,357	.....	.....	[a]250,343	20,213
	.....	.....	.....	.....	[a]220,081	17,733
	122,573	13,020	12,252	927	272,111	83,117
	80,079	11,440	151,323	11,684	[b]22,895	31,660
	116,520	15,046	[c]745,496	46,924	9,800	1,163
	142,884	20,692	539,512	36,991	2,808	294
	151,281	23,369	426,659	29,897	6,018	1,030
	138,600	22,177	840,074	60,340	19,956	2,927
	144,150	23,504	997,257	70,291	9,565	1,478
	165,170	32,445	98,854	7,562	11,770	2,801
	118,852	21,828	90,214	5,722	3,050	548
	105,596	18,440	33,696	2,435	2,563	503
	96,254	17,577	19,649	1,717	1,882	268
	75,468	12,507	46,137	3,248	12,816	1,327
	73,774	14,193	42,428	3,112	12,524	1,167
	67,967	11,886	31,771	1,844	2,295	228
	56,305	9,774	31,181	1,476	1,500	170
	88,447	12,304	30,446	1,770	712	75
	77,423	14,341	28,647	2,026	1,655	225
	74,182	14,190	33,266	2,721	2,944	386
	107,810	21,181	50,651	4,509	1,387	200
	134,554	24,315	27,393	2,269	1,021	122
	139,158	23,893	45,165	2,975	561	62
	152,875	27,010	37,529	2,367	489	53
	191,378	32,537	28,831	1,591	782	83
	214,078	35,447	18,019	1,132	1,263	136
	272,130	45,900	13,719	978	1,073	88
	251,080	48,366	10,127	621	1,524	122
	211,332	39,892	11,267	808	1,795	187
	230,145	43,532	13,894	997	1,945	222
	247,784	47,540	12,822	1,054	6,051	510
	215,340	40,006	8,658	679	2,065	245
	265,264	45,716	12,245	835	2,015	210
	275,503	44,906	20,847	1,560	2,116	201
	253,683	40,346	9,660	543	1,423	139
	280,140	47,903	7,302	636	5,147	314
	265,245	45,833	16,628	1,585	1,766	181
	287,697	50,009	24,203	2,765	8,291	1,807
	285,942	50,505	11,663	1,116	3,084	290
	387,348	71,764	12,652	1,076	2,260	187
	.....	.....	.....	.....	.....	.....

ludes tallow.
antity not given for Canada.
om 1867 to 1902 the imports are for home consumption, prior to 1867 they are the total ts.
ports of meat products of hogs were not separately enumerated for this year.

The imports of bristles into the United States from 1816 to the present time are also presented here as affording opportunity for some interesting comparisons.

Imports of bristles, 1816 to 1903.

Fiscal year.[a]	Quantity.	Value.	Fiscal year.	Quantity.	Value.	Fiscal year.	Quantity.	Value.
	Pounds.	*Dollars.*		*Pounds.*	*Dollars.*		*Pounds.*	*Dollars.*
1816	4,731	.....	1846	445,725	244,719	1876	588,834	622,170
1817	88,809	.....	1847	420,682	191,473	1877	450,056	526,490
1818	99,810	.....	1848	485,661	175,025	1878	623,670	682,985
1819	144,726	.....	1849	221,045	88,265	1879	417,234	474,388
1820	.....	.....	1850	303,613	152,702	1880	984,285	1,010,495
1821	84,867	.....	1851	465,645	244,694	1881	838,840	911,520
1822	203,472	.....	1852	464,918	313,130	1882	862,072	1,032,255
1823	91,389	.....	1853	389,200	253,731	1883	1,020,909	1,228,543
1824	184,432	.....	1854	659,363	349,154	1884	988,736	1,201,735
1825	175,346	56,606	1855	507,847	315,113	1885	790,502	926,760
1826	121,852	49,069	1856	376,869	243,964	1886	1,076,330	1,087,135
1827	252,181	85,433	1857	470,845	289,581	1887	1,196,242	1,174,338
1828	404,847	132,242	1858	443,727	265,720	1888	1,114,214	1,215,325
1829	103,958	26,414	1859	329,088	222,179	1889	1,330,787	1,294,724
1830	115,551	26,518	1860	626,810	437,450	1890	1,261,609	1,296,219
1831	245,486	74,776	1861	569,311	396,871	1891	1,404,832	1,357,998
1832	410,206	110,722	1862	137,776	108,780	1892	1,495,008	1,455,056
1833	273,769	101,293	1863	271,851	218,279	1893	1,598,818	1,508,254
1834	146,514	69,337	1864	264,532	222,164	1894	892,520	929,221
1835	98,487	53,107	1865	266,827	220,004	1895	1,301,494	1,244,151
1836	362,169	216,034	1866	1,131,366	674,958	1896	1,572,530	1,435,348
1837	250,599	142,740	1867	831,422	689,300	1897	1,347,900	1,217,179
1838	115,190	30,413	1868	520,355	556,097	1898	1,535,090	1,249,119
1839	497,339	195,026	1869	.....	589,135	1899	1,856,577	1,458,252
1840	235,799	94,325	1870	.....	629,057	1900	2,530,158	2,152,867
1841	297,806	150,130	1871	.....	727,588	1901	1,684,575	1,730,197
1842	.....	74,395	1872	588,181	781,238	1902	2,013,109	2,047,361
1843[b]	26,695	8,271	1873	632,203	811,322	1903	3,043,865	2,654,484
1844	190,638	84,011	1874	522,006	645,102			
1845	343,218	172,076	1875	495,054	627,845			

[a] The fiscal year ended September 30, up to and including 1842; thereafter, June 30.
[b] For nine months only, owing to change in fiscal year.

The Treasury statistics do not give the importations of live hogs separately. The number imported during recent years is shown by the records of the Inspection Division of the Bureau of Animal Industry. Since the establishment of inspections November 15, 1890, these are as follows:

Imports of live hogs.

Fiscal year.	Canada.	Mexico.	Atlantic seaboard.	Total.
November 15, 1890, to June 30, 1891	29	.....	70	99
1892	74	.....	2	76
1893	16,008	.....	24	16,032
1894	1,302	.....	43	1,345
1895	908	.....	23	931
1896	216	42	30	288
1897	212	12	55	279
1898	375	104	10	489
1899	196	64	47	307
1900	1,096	44	2	1,142
1901	443	.....	74	[a]517
1902	5,370	64	12	5,453

[a] Including 7 hogs quarantined at San Francisco.

IMPORTS OF PORK PRODUCTS INTO THE UNITED KINGDOM.

The following table has been compiled from British trade reports to show the relative importance of American hog products on that market.[a] As the United Kingdom imports bacon to a greater extent than any other hog meat, and as the English figures show very striking comparisons between American bacon and that from other sources, this table has been arranged to show the British imports since 1888, the year that the bacon imports from Denmark, our strongest competitor, were first reported separately. The figures show total quantities, total values, and values per 100 pounds.

[a] In comparing the English import figures of pork products with the United States export statistics discrepancies will be noticed, especially in the commerce in bacon and pork ("fresh and salted"). As the accuracy of the figures are not to be questioned in either case, the following explanation from the reports of the British Board of Trade is interesting: "A considerable amount of Canadian produce finds its way to the United Kingdom via the ports of the United States in winter, when many Canadian ports are closed by ice. To a limited extent produce from the United States is sent to the United Kingdom via Canadian ports in the summer. Where, in such cases, the official documents enable a distinction to be drawn between Canadian and United States produce it is credited to the true country of origin. But in many cases such a distinction can not be made, so that in using the statistics it should be remembered that a certain amount of the trade of Canada with this country, especially in winter, is unavoidably included under the heading 'United States.'"—(Trade and Navigation of the United Kingdom, December, 1899, pp. II, III.)

Imports of pork products into the United Kingdom, 1888 to 1902.

[From Trade and Navigation, published by the British Government.]

Article and country.	1888.			1889.		
	Quantity.	Value.	Value per 100 pounds.	Quantity.	Value.	Value per 100 pounds.
Fresh pork:	*Pounds.*	*Dollars.*	*Dollars.*	*Pounds.*	*Dollars.*	*Dollars.*
Holland	21,416,416	2,107,467	9.84	10,061,680	1,021,496	10.15
Belgium	3,913,168	399,691	10.21	1,672,048	183,102	10.95
United States	896	88	9.82	784	49	6.25
Other countries	1,860,656	203,172	10.92	1,332,240	147,849	11.10
Total	27,191,136	2,710,418	9.97	13,066,752	1,352,496	10.34
Bacon:						
Denmark	58,371,376	6,689,778	11.46	64,434,048	7,979,856	12.38
United States	208,894,560	18,750,485	8.98	205,336,016	23,410,094	8.99
Other countries[a]	52,442,096	5,671,122	10.81	42,022,064	4,073,241	9.69
Total	319,708,032	31,111,385	9.73	291,792,128	35,463,193	9.65
Hams:						
United States	72,427,264	8,257,233	11.40	97,810,048	10,789,454	11.03
Other countries	9,142,896	1,105,012	12.09	11,692,048	1,284,018	11.85
Total	81,570,160	9,362,285	11.48	109,492,096	12,173,472	11.12
Pork, salted (not bacon or hams):						
United States	16,746,800	1,156,441	6.91	21,477,904	1,376,284	6.41
Other countries	10,699,992	595,115	5.57	8,715,840	522,901	6.00
Total	27,427,792	1,751,556	6.39	30,193,744	1,899,225	6.29

Article and country.	1890.			1891.		
	Quantity.	Value.	Value per 100 pounds.	Quantity.	Value.	Value per 100 pounds.
Fresh pork:	*Pounds.*	*Dollars.*	*Dollars.*	*Pounds.*	*Dollars.*	*Dollars.*
Holland	2,911,328	301,485	10.36	10,092,768	1,049,553	10.40
Belgium	1,219,456	133,328	10.93	3,508,064	367,608	10.48
United States	6,720	457	6.80	(b)	.....	.....
Other countries	935,536	99,238	10.61	681,184	56,052	8.23
Total	5,073,040	534,508	10.54	14,282,016	1,473,211	10.32
Bacon:						
Denmark	52,176,992	6,492,378	12.44	65,057,216	7,703,076	11.84
United States	328,660,080	23,802,013	7.24	299,606,048	21,985,217	7.34
Canada	(b)	.....	.....	16,924,208	1,382,646	8.17
Other countries[a]	43,706,768	3,664,343	8.38	11,555,936	1,292,864	11.19
Total	424,543,840	33,958,734	8.09	393,143,408	32,363,803	8.23
Hams:						
United States	122,570,896	12,573,795	10.26	125,041,392	12,558,359	10.04
Canada	.....	.....	.....	9,372,160	955,274	10.19
Other countries	12,887,056	1,388,753	10.78	524,384	70,895	13.52
Total	135,457,952	13,962,548	10.31	134,937,936	13,584,528	10.07
Pork, salted (not bacon or hams):						
United States	22,912,624	1,373,300	5.99	19,048,400	1,132,692	5.95
Other countries	5,631,360	288,340	5.12	6,352,976	307,461	4.84
Total	28,543,984	1,661,540	5.82	25,401,376	1,440,153	5.67

[a] In 1888 Germany exported to the United Kingdom 28,337,792 pounds of bacon, valued at $3,244,084, which is equivalent to $11.45 per 100 pounds. In 1889 the amount dropped to 7,127,568 pounds, and in 1890 to 155,680 pounds, and since that time small quantities have annually appeared until 1895, when they were dropped from the returns.

[b] Not separately enumerated.

Imports of pork products into the United Kingdom, 1888 to 1902—Continued.

Article and country.	1892.			1893.		
	Quantity.	Value.	Value per 100 pounds.	Quantity.	Value.	Value per 100 pounds.
Fresh pork:	*Pounds.*	*Dollars.*	*Dollars.*	*Pounds.*	*Dollars.*	*Dollars.*
Holland	10,394,496	1,042,487	10.03	13,568,464	1,414,142	10.42
Belgium	2,522,464	271,249	10.75	2,826,096	308,643	10.92
Other countries	1,879,024	195,682	10.41	4,111,632	494,120	12.02
Total	14,795,984	1,509,418	10.20	20,506,192	2,216,905	10.81
Bacon:						
Denmark	75,250,784	9,340,746	12.41	79,727,648	10,453,914	13.11
United States	324,346,512	26,057,212	8.03	243,856,816	26,879,855	11.02
Canada	26,781,552	2,251,467	8.41	21,702,576	2,409,725	11.10
Other countries[a]	8,335,488	942,510	11.31	12,988,304	1,523,526	11.73
Total	434,714,336	38,591,935	8.88	358,275,344	41,267,020	11.52
Hams:						
United States	126,703,248	12,988,314	10.25	103,147,632	13,074,548	12.68
Canada	12,790,176	1,322,150	10.34	6,471,360	837,758	12.95
Other countries	857,360	112,440	13.11	1,083,040	153,105	14.14
Total	140,350,784	14,422,904	10.28	110,702,032	14,065,411	12.71
Pork, salted (not bacon or hams):						
United States	18,168,640	1,135,564	6.25	12,186,832	950,140	7.80
Other countries	7,407,008	354,860	4.79	8,748,320	459,086	5.25
Total	25,575,648	1,490,424	5.83	20,935,152	1,409,226	6.73

Article and country.	1894.			1895.		
	Quantity.	Value.	Value per 100 pounds.	Quantity.	Value.	Value per 100 pounds.
Fresh pork:	*Pounds.*	*Dollars.*	*Dollars.*	*Pounds.*	*Dollars.*	*Dollars.*
Holland	14,954,912	1,540,121	10.30	27,521,312	2,768,401	10.06
Belgium	3,425,520	374,896	10.94	3,040,800	327,418	10.77
Other countries	1,822,464	209,435	11.49	1,725,696	140,141	8.12
Total	20,202,896	2,124,452	10.52	32,287,808	3,235,960	10.02
Bacon:						
Denmark	85,884,736	10,655,640	12.41	113,560,160	12,189,108	10.73
United States	286,854,736	24,736,181	8.62	296,741,984	22,318,202	7.52
Canada	28,497,616	2,557,117	8.97	30,115,232	2,437,314	8.09
Other countries[a]	11,998,560	1,391,298	11.60	14,685,440	1,627,153	11.08
Total	413,235,648	39,340,236	9.52	455,102,816	38,571,777	8.48
Hams:						
United States	120,490,240	12,805,085	10.63	134,753,584	13,127,316	9.74
Canada	5,664,512	619,291	10.93	9,151,184	905,855	9.90
Other countries	441,056	64,724	14.68	521,248	70,034	13.44
Total	126,595,808	13,489,100	10.66	144,426,016	14,103,205	9.77
Pork, salted (not bacon or hams):						
United States	16,820,832	1,152,767	6.85	13,765,024	828,882	6.02
Other countries	8,381,296	480,216	5.73	10,893,792	484,241	4.45
Total	25,202,128	1,632,983	6.48	24,658,816	1,313,123	5.33

[a] See note [a], page 272.

Imports of pork products into the United Kingdom, 1888 to 1903—Continued.

Article and country.	1896.			1897.		
	Quantity.	Value.	Value per 100 pounds.	Quantity.	Value.	Value per 100 pounds.
Fresh pork:	*Pounds.*	*Dollars.*	*Dollars.*	*Pounds.*	*Dollars.*	*Dollars.*
Holland	27,305,528	2,708,359	9.90	25,336,080	2,378,526	9.39
Belgium	4,391,296	478,572	10.90	4,125,184	455,492	10.92
United States	.....	.....	.....	.....	.....	.....
Other countries	1,776,208	157,548	8.87	9,471,840	894,477	9.34
Total	33,534,032	3,344,459	9.97	38,933,104	3,728,495	9.58
Bacon:						
Denmark	136,876,768	13,586,266	9.93	114,973,824	13,355,769	11.62
United States	308,170,016	19,790,634	6.42	402,375,120	26,053,411	6.47
Canada	51,152,976	3,385,347	6.62	32,511,696	2,546,128	7.83
Other countries[a]	13,347,152	1,461,751	10.95	10,689,846	1,200,064	11.23
Total	509,546,912	38,223,998	7.50	560,550,486	43,155,372	7.70
Hams:						
United States	144,029,312	13,424,114	9.32	179,595,696	16,692,352	9.29
Canada	18,958,912	1,778,326	9.38	13,342,896	1,266,614	9.49
Other countries	465,920	59,337	12.74	359,408	49,322	13.72
Total	163,454,144	15,261,777	9.34	193,298,000	17,918,288	9.27
Pork, salted (not bacon or hams):						
United States	15,419,376	856,888	5.56	15,839,936	815,139	5.15
Other countries	13,178,592	563,964	4.28	10,727,136	419,458	3.91
Total	28,597,968	1,420,852	4.97	26,567,072	1,234,597	4.65

Article and country.	1898.			1899.		
	Quantity.	Value.	Value per 100 pounds.	Quantity.	Value.	Value per 100 pounds.
Fresh pork:	*Pounds.*	*Dollars.*	*Dollars.*	*Pounds.*	*Dollars.*	*Dollars.*
Holland	24,939,264	2,308,969	9.26	38,596,752	3,541,045	9.18
Belgium	3,931,424	429,508	10.92	3,958,304	447,699	11.31
United States	.....	.....	.....	31,006,528	2,692,907	8.68
Other countries	33,580,735	2,932,845	8.73	1,393,280	146,248	10.50
Total	62,451,424	5,671,322	9.08	74,924,864	6,827,899	9.11
Bacon:						
Denmark	113,962,240	13,144,962	11.53	135,588,544	14,335,328	10.57
United States	457,787,536	31,331,690	6.84	457,917,152	31,896,184	6.96
Canada	60,018,448	4,845,209	8.07	50,822,576	3,707,597	7.29
Other countries[a]	7,899,808	908,566	11.50	5,785,024	685,223	11.84
Total	639,668,064	50,230,427	7.85	650,113,296	50,614,530	7.79
Hams:						
United States	207,370,240	17,769,606	8.57	204,284,080	18,400,271	9.01
Canada	13,151,936	1,135,218	8.63	16,878,176	1,465,848	8.68
Other countries	375,312	49,410	13.17	443,856	59,765	13.46
Total	220,897,488	18,954,234	8.58	221,606,112	19,925,884	8.99
Pork, salted (not bacon or hams):						
United States	19,600,000	1,092,695	5.57	18,372,704	972,570	5.30
Other countries	11,311,216	463,505	4.10	13,515,936	515,747	3.82
Total	30,911,216	1,556,200	5.03	31,888,640	1,488,317	4.67

[a] See note [a], p. 272.

Imports of pork products into the United Kingdom, 1888 to 1902—Continued.

Article and country.	1900.			1901.		
	Quantity.	Value.	Value per 100 pounds.	Quantity.	Value.	Value per 100 pounds.
Fresh pork:	*Pounds.*	*Dollars.*	*Dollars.*	*Pounds.*	*Dollars.*	*Dollars.*
Holland	43,588,608	4,009,149	9.20	42,230,832	3,896,748	9.23
Belgium	5,771,024	618,084	10.71	4,533,984	477,511	10.53
United States	23,673,048	2,445,991	9.17	39,080,720	3,713,105	9.50
Other countries	1,848,560	204,106	11.04	2,803,472	261,764	9.34
Total	77,884,240	7,277,330	9.34	88,649,008	8,349,128	9.42
Bacon:						
Denmark	122,596,112	14,885,563	12.14	118,821,808	15,749,480	13.25
United States	443,131,024	36,459,541	8.23	475,394,848	45,043,599	9.48
Canada	59,744,768	5,233,653	8.82	44,654,064	4,484,524	10.04
Other countries[a]	6,744,752	719,264	10.66	7,662,256	867,989	11.33
Total	631,818,656	57,298,021	9.07	646,502,976	66,136,592	10.23
Hams:						
United States	179,474,736	18,311,248	10.20	193,820,032	20,487,070	10.57
Canada	21,972,384	2,175,043	9.90	14,097,104	1,483,416	10.52
Other countries	451,920	59,143	13.09	477,904	66,914	14.00
Total	201,899,040	20,545,434	10.18	208,395,040	22,037,400	10.57
Pork, salted (not bacon or hams):						
United States	14,381,024	864,636	6.01	15,420,160	1,011,531	6.56
Other countries	13,476,512	601,879	4.47	12,249,440	566,032	4.62
Total	27,857,536	1,466,515	5.26	27,669,600	1,577,563	5.70

Article and country.	1902.		
	Quantity.	Value.	Value per 100 pounds.
Fresh pork:	*Pounds.*	*Dollars.*	*Dollars.*
Holland	39,580,576	3,660,041	9.25
Belgium	3,881,472	407,433	10.50
United States	28,271,152	2,785,234	9.85
Other countries	1,668,912	184,956	11.08
Total	73,402,112	7,037,664	9.59
Bacon:			
Denmark	140,630,224	18,245,634	12.97
United States	367,791,760	40,097,634	10.90
Canada	51,798,544	5,855,762	11.30
Other countries[a]	9,826,320	1,143,905	11.64
Total	570,046,848	65,342,335	11.46
Hams:			
United States	147,031,248	16,653,182	11.33
Canada	18,360,160	2,045,482	11.14
Other countries	624,736	81,168	12.99
Total	166,016,144	18,779,832	11.31
Pork, salted (not bacon or hams):			
United States	11,807,264	910,688	7.71
Other countries	11,182,416	576,452	5.15
Total	22,989,680	1,487,140	6.47

[a] See note a, p. 272.

Referring to the imports for the year ended December 31, 1902, we see that of the total imports into the United Kingdom of meat products of hogs there were imported 73,402,112 pounds of fresh pork, or 8.82 per cent of the total amount, valued at $7,037,664, or $9.59 per 100 pounds; 570,046,848 pounds of bacon, 68.61 per cent of the total amount, valued at $65,342,335, or $11.46 per 100 pounds; 166,016,144 pounds of hams, which were 19.94 per cent of the total, and valued at $18,779,832, or $11.31 per 100 pounds, and 22,989,680 pounds of salted pork (not bacon or hams), which were 2.63 per cent of the total amount of meat products of hogs imported, and were valued at $1,487,140, an average value per 100 pounds of $6.47.

Except for very small amounts, fresh pork from the United States was first reported separately in 1899, when 31,006,528 pounds, valued at $2,692,907, were imported. The bulk of this product now reaches the United Kingdom from Holland and the United States, Holland furnishing a somewhat larger amount, which generally, although not always, sells for slightly more than the fresh pork from America. In quality the Belgian fresh pork is ranked higher than that from either Holland or the United States, but the imports from that source do not form a very large proportion of the total of the fresh pork imported in 1902. Holland furnished 39,580,576 pounds, or 53.92 per cent, valued at $3,660,041, and the United States furnished 28,271,152 pounds, or 38.52 per cent of the total amount, and valued at $2,785,234; Belgium furnished 3,881,472 pounds, or 5.29 per cent, valued at $407,433. The value per 100 pounds of the pork from Belgium was $10.50, that from Holland $9.25, and that from the United States $9.85.

The United States is easily the principal source of hams that are imported into the United Kingdom. Until 1891 this country was the only one whose imports were separately enumerated. For that year Canada is reported with 9,372,160 pounds, valued at $955,274, which is $10.19 per 100 pounds. Until 1899 the Canadian hams had a greater value per 100 pounds than those of the United States, since which date the hams from the United States have had the greater value per 100 pounds. There were imported in 1902, 166,016,144 pounds of hams, of which the United States furnished 147,031,248 pounds, or 88.56 per cent; Canada furnished 18,360,160 pounds, or 11.06 per cent.

Although there has not been a marked tendency toward decreased importations of salted pork (not bacon or hams) from the United States, other countries not enumerated are gradually selling the United Kingdom a larger proportion of this product. In 1902 there were credited to the United States 11,807,264 pounds, or 51.37 per cent of the total amount imported, valued at $910,688. The value per 100 pounds of the United States product in 1902 was $7.71, which is $1.24 above the average value per 100 pounds of all imported.

Attention is now called to the imports of bacon into the United

Kingdom. As is well known, the English people consume large quantities of bacon, and are generally regarded as being accurate judges of this product, the English market being the most critical in the world for bacon. While the highest prices are supposed to be obtained by the native Wiltshire and the Irish bacon, great quantities are imported, bacon comprising 68.61 per cent of the total imports of meat products of hogs in 1902. In the year ended December 31, 1902, the United States supplied 367,791,760 pounds of the total amount of bacon imported, which had a total value of $40,097,634 and an average value per 100 pounds of $10.90. This was 64.52 per cent of the total amount and 61.36 per cent of the total value of bacon imported. From Denmark 140,630,224 pounds were imported—24.67 per cent of the total amount—with a valuation of $18,245,034, 27.92 per cent of the total value, and an average value per 100 pounds of $12.97. Canada is credited with 51,798,544 pounds—9.09 per cent of the total amount—valued at $5,855,762, or 8.97 per cent of the total value, and an average value per 100 pounds of $11.30. A more careful examination of the table shows that never since Danish or Canadian bacon have been separately reported in the British customs reports have the prices per 100 pounds for bacon from the United States been equal to that of the bacon from these countries, the difference between United States bacon and Danish bacon being particularly striking in this respect. This discrimination against the bacon from this country is not a new subject for discussion. In his report for 1894 the Secretary of Agriculture called particular attention to the need of careful study by the producers in the United States if they wished to supply this market with a product that is really desirable according to the English standards, and the subject has often been referred to in the press.

During the fifteen years for which we have figures regarding Danish bacon the valuation per 100 pounds has been less than $11 in three years only (1895, 1896, and 1899), and in one year only (1896) has it fallen below $10, when a valuation of $9.93 was reached. In the years 1893 and 1901 it was more than $13. On the other hand, in the years 1893, 1901, and 1902 only has bacon from the United States had a valuation of more than $9 per 100 pounds, and in the years 1893 and 1902 only, when extremely high prices were recorded in this country for live hogs, has the valuation been in the neighborhood of $11 per 100 pounds, being $11.02 and $10.90, respectively, in these years. In no year has it sold up to the average valuation per 100 pounds of the total imports of bacon into the United Kingdom. In three years—1888, 1893, and 1902, all years of high prices in this country—the difference in value per 100 pounds between Danish and United States bacon has been less than $2.50, as follows: 1888, $2.48; 1893, $2.09; 1902, $2.07. In 1895 the difference was less than $3.50, but in all other years it was more than $3.50, a difference of more than $4 being noticed in the years 1889, 1890, 1891, 1892, 1897, and

1898, and a difference of over $5 in the years 1890 and 1897. The greatest difference was in 1890, when the Danish bacon averaged $5.20 per 100 pounds more than that from this country. The average valuation per 100 pounds of all bacon imported into the United Kingdom for the entire period from 1888 to 1902 was $8.94; that of the United States bacon was $8.07, and that of the Danish bacon, $11.83, a difference of $3.76 in favor of the Danish bacon.

A further evidence of the fact that Danish bacon stands higher in the esteem of the English people than that produced in the United States is that there is less fluctuation in its value in periods of greatest supply. If we take the periods immediately preceding the years 1893 and 1902, when the prices of hogs reached extreme points in the United States, and exports from this country diminished very noticeably, we find a range in value per 100 pounds in the Danish bacon from $11.46 to $12.44 during the years 1888 to 1892, a fluctuation of $0.98, and during the years 1894 to 1901, a range from $9.93 to $13.25, a difference of $3.32. The values reached during the years 1893 and 1902, immediately following the above periods, were $13.11 and $12.97, respectively, the year 1902 showing a slight decrease in the value of the Danish product. The extreme range including the year of highest value is $1.65 during the years from 1888 to 1893. The extreme range during the later period is $3.32, and is shown by the returns for the years 1896 and 1901. During these two periods the United States bacon ranged in valuation from $7.24 to $8.98 in the years 1888 to 1892 and reached a valuation per 100 pounds of $11.02 in 1893, showing a fluctuation in normal years of $1.74 and an extreme fluctuation of $3.78. During the years 1894 to 1901 the range is from $6.42 in 1896 to $9.48 in 1901, the extreme of $10.90 being reached in 1902, thus showing a fluctuation in normal years of $3.06, and an extreme fluctuation, including the year of scarcity of supply and high prices, of $4.48.

These figures would seem to indicate that the Danish bacon is a finer product than the United States bacon; that a more constant demand exists for it on the English market, and that it supplies a finer trade than bacon from the United States. It is evident that the English people buy American bacon because it is in abundance and cheap in price, and they only pay well for it when forced to do so by scarcity and high prices in the country of production.

A somewhat surprising feature that is shown by these figures is the rating of bacon from Canada, which, while it shows a higher rating on the English market than the United States bacon, does not greatly exceed the average valuation from year to year, and seems to be affected by conditions similar to those that govern the valuations of the bacon from the United States. During the years 1888–1902 the average valuation of the Canadian bacon imported into the United Kingdom was $8.96—2 cents per 100 pounds more than the average and 89 cents more than the United States bacon, but $2.87 less than that from Denmark.

MISCELLANEOUS TRADE STATISTICS.

Having devoted attention to the total production and foreign trade of hogs and hog products, it is of much interest to study the figures showing the stocks in the country after the foreign demand and the local consumption have been supplied. The total production, less the sum of the foreign consumption during a given period, and the stocks on hand at the close of the period will represent quite accurately the home consumption for that period. The following table gives a comparison of the aggregate stocks of hog meats (including pork) and lard in the West, in the East, and in transit on March 1 for the years of 1881 to 1903, inclusive:

Comparison of the aggregate of meats (including pork) and lard in the West, in the East, and in transit on March 1, 1881 to 1903.

[Cincinnati Price Current.]

Year.	Meats and pork.	Lard.	Total product.	Year.	Meats and pork.	Lard.	Total product.
	Pounds.	*Pounds.*	*Pounds.*		*Pounds.*	*Pounds.*	*Pounds.*
1881	414,000,000	86,000,000	500,000,000	1893	299,000,000	22,000,000	321,000,000
1882	406,000,000	106,000,000	512,000,000	1894	336,000,000	24,000,000	360,000,000
1883	445,000,000	88,000,000	533,000,000	1895	555,000,000	48,000,000	603,000,000
1884	329,000,000	81,000,000	410,000,000	1896	476,000,000	74,000,000	550,000,000
1885	427,000,000	76,000,000	503,000,000	1897	510,000,000	134,000,000	644,000,000
1886	453,000,000	99,000,000	552,000,000	1898	591,000,000	94,000,000	685,000,000
1887	396,000,000	78,000,000	474,000,000	1899	696,000,000	97,000,000	793,000,000
1888	408,000,000	61,000,000	469,000,000	1900	511,000,000	72,000,000	583,000,000
1889	380,000,000	42,000,000	422,000,000	1901	519,000,000	41,000,000	560,000,000
1890	426,000,000	53,000,000	479,000,000	1902	565,000,000	52,000,000	617,000,000
1891	686,000,000	113,000,000	799,000,000	1903	446,000,000	29,000,000	475,000,000
1892	611,000,000	80,000,000	691,000,000				

APPARENT DOMESTIC CONSUMPTION OF MEAT PRODUCTS OF HOGS.

The following table is an estimate of the apparent annual domestic consumption of the meat products of hogs, including barreled pork, also the monthly average, for 1890 to 1903:

Apparent domestic consumption of meat products of hogs (including barreled pork) from 1891 to 1903.

[Cincinnati Price Current.]

SUMMER SEASON—MARCH 1 TO NOVEMBER 1.

Year.	Total.	Monthly average.
	Pounds.	*Pounds.*
1902	1,767,000,000	221,000,000
1901	1,800,000,000	226,000,000
1900	1,802,000,000	225,000,000
1899	1,857,000,000	232,000,000
1898	1,756,000,000	219,000,000
1897	1,578,000,000	197,000,000
1896	1,468,000,000	183,000,000
1895	1,327,000,000	166,000,000
1894	1,222,000,000	153,000,000
1893	1,060,000,000	132,000,000
1892	1,429,000,000	179,000,000
1891	1,346,000,000	168,000,000

Apparent domestic consumption of meat products of hogs, etc.—Continued.

WINTER SEASON—NOVEMBER 1 TO MARCH 1.

Year.	Total.	Monthly average.
	Pounds.	*Pounds.*
1902-03	797,000,000	132,000,000
1901-02	807,000,000	202,000,000
1900-01	894,000,000	216,000,000
1899-00	842,000,000	228,000,000
1898-99	787,000,000	197,000,000
1897-98	739,000,000	182,000,000
1896-97	662,000,000	165,000,000
1895-96	628,000,000	156,000,000
1894-95	608,000,000	151,000,000
1893-94	504,000,000	126,000,000
1892-93	512,000,000	128,000,000
1891-92	807,000,000	202,000,000

TWELVE MONTHS ENDED MARCH 1.

1902-03	2,564,000,000	213,000,000
1901-02	2,630,000,000	219,000,000
1900-01	2,666,000,000	222,000,000
1899-00	2,699,000,000	225,000,000
1898-99	2,542,000,000	212,000,000
1897-98	2,308,000,000	192,000,000
1896-97	2,120,000,000	177,000,000
1895-96	1,950,000,000	162,000,000
1894-95	1,885,000,000	132,000,000
1893-94	1,564,000,000	130,000,000
1892-93	1,942,000,000	162,000,000
1891-92	2,153,000,000	179,000,000

DOMESTIC AND EXPORT CONSUMPTION OF LARD.

The following table shows the estimated domestic and export consumption of lard from 1892–93 to 1902–03:

Domestic and export consumption of lard, 1892–93 to 1902–03.

[Cincinnati Price Current.]

Year.	Domestic.	Export.	Total.	Year.	Domestic.	Export.	Total.
	Tierces.	*Tierces.*	*Tierces.*		*Tierces.*	*Tierces.*	*Tierces.*
1902-03	795,000	1,594,000	2,389,000	1896-97	658,000	1,600,000	2,258,000
1901-02	1,077,000	1,700,000	2,777,000	1895-96	390,000	1,503,000	1,893,000
1900-01	1,091,000	1,857,000	2,948,000	1894-95	496,000	1,470,000	1,966,000
1899-00	870,000	2,067,000	2,937,000	1893-94	495,000	1,130,000	1,625,000
1898-99	673,000	2,230,000	2,903,000	1892-93	423,000	1,306,000	1,729,000
1897-98	768,000	1,990,000	2,758,000				

COMPARATIVE MONTHLY AND YEARLY PRICES OF HOGS.

Highest monthly and yearly prices of hogs at Chicago per 100 pounds from 1881 to 1902.

[Cincinnati Price Current.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
1902	$6.85	$6.55	$7.00	$7.50	$7.50	$7.95	$8.25	$7.95	$8.20	$7.92	$6.95	$6.90	$8.25
1901	5.47	5.65	6.20	6.25	6.00	6.30	6.40	6.70	7.40	7.10	6.30	6.70	7.40
1900	4.92	5.10	5.55	5.85	5.57	5.42	5.55	5.57	5.70	5.55	5.12	5.10	5.85
1899	4.05	4.05	4.00	4.15	4.05	4.00	4.70	5.00	4.90	4.90	4.35	4.45	5.00
1898	4.00	4.27	4.17	4.15	4.80	4.50	4.17	4.20	4.15	4.00	3.85	3.75	4.80
1897	3.60	3.75	4.25	4.25	4.05	3.65	4.00	4.55	4.65	4.40	3.80	3.60	4.65
1896	4.45	4.35	4.25	4.15	3.75	3.60	3.70	3.70	3.50	3.65	3.70	3.60	4.45
1895	4.80	4.65	5.30	5.42	4.97	5.10	5.70	5.40	4.65	4.50	3.85	3.75	5.70
1894	5.65	5.50	5.25	5.60	5.35	5.20	6.00	6.15	6.75	6.15	5.05	4.90	6.75
1893	8.40	8.75	8.55	7.90	8.00	7.45	6.45	6.30	7.05	7.00	6.50	6.60	8.75
1892	4.75	5.05	5.10	5.00	5.10	5.75	6.10	6.20	5.70	5.97	6.07	7.00	7.00
1891	3.85	3.80	5.15	5.50	5.15	4.85	5.85	5.90	5.75	5.50	4.40	4.15	5.90
1890	4.00	4.15	4.45	4.50	4.35	4.05	4.05	4.40	4.95	4.80	4.35	3.90	4.95
1889	5.35	5.05	5.10	5.05	4.85	4.65	4.80	4.80	4.85	4.85	4.25	3.85	5.35
1888	6.00	5.80	5.95	5.90	5.90	5.90	6.75	6.75	6.90	6.90	6.80	5.50	6.90
1887	5.15	5.05	6.10	5.95	5.55	5.35	5.75	5.55	5.60	4.90	5.50	5.90	6.10
1886	4.40	4.65	4.65	4.55	4.40	4.70	5.25	5.25	5.20	4.80	4.20	5.00	5.25
1885	5.05	5.35	5.05	4.85	4.55	4.35	5.30	5.35	4.80	4.35	4.00	4.10	5.35
1884	6.75	7.75	7.60	7.10	6.20	5.90	5.85	6.90	6.90	5.90	5.05	4.60	7.75
1883	7.10	7.65	8.10	8.15	7.90	7.25	6.60	6.50	6.00	5.40	5.50	6.15	8.15
1882	7.35	7.50	7.65	7.80	8.60	8.75	9.00	9.50	9.30	9.25	7.75	7.00	9.50
1881	5.90	6.75	6.75	6.65	6.60	6.35	7.10	7.00	7.50	7.40	6.90	6.65	7.50

PRICES OF HOG PRODUCTS.

Prices of mess pork, D. S. short-rib sides, S. P. hams, and S. P. shoulders at Chicago, March 1, 1881, to 1903.

[Cincinnati Price Current.]

Year.	Mess pork.	Lard.	S. R. sides.	Hams.	Shoulders.
	Per barrel.	*100 pounds.*	*100 pounds.*	*100 pounds.*	*100 pounds.*
1903	$18.25	$9.70	$9.75	$10.80	$8.55
1902	13.25	8.95	8.25	9.40	7.00
1901	13.90	7.35	7.00	8.75	6.50
1900	10.50	5.75	5.75	9.25	6.50
1899	9.25	5.25	4.65	7.00	4.50
1898	10.35	5.10	5.00	7.15	5.00
1897	8.00	4.00	4.20	8.50	4.75
1896	9.75	5.35	5.05	8.00	5.25
1895	10.20	6.40	5.15	8.25	5.15
1894	11.85	7.05	6.10	9.00	6.90
1893	18.25	12.70	10.20	13.50	10.00
1892	11.15	6.42½	5.82½	8.40	5.00
1891	9.65	5.65	4.67½	6.85	3.45
1890	9.80	5.85	4.80	8.40	4.50
1889	11.15	6.70	5.90	9.00	5.50
1888	13.90	7.70	7.15	9.50	6.12½
1887	18.25	7.05	7.65	11.00	7.00
1886	10.45	5.85	5.30	8.00	4.37½
1885	12.40	6.80	6.10	8.62½	5.37½
1884	17.80	9.40	9.25	12.25	7.75
1883	18.20	11.42½	9.85	11.00	8.00
1882	17.00	10.40	9.00	10.25	6.75
1881	14.37½	10.00	7.32½	8.50	5.50

For 1887 the price of mess pork on March 1 was influenced fully $3.50 per barrel by manipulation.

CHICAGO PORK AND LARD PRICES.

Lowest, highest, and average yearly prices at Chicago for mess pork per barrel and lard per hundred pounds, 1870 to 1902.

[Cincinnati Price Current.]

Year.	Pork.			Lard.		
	Low.	High.	Average.	Low.	High.	Aver.
1870	$18.00	$30.50	$26.25	$11.00	$17.25	$15.00
1871	12.00	23.00	15.90	8.37	13.00	10.25
1872	11.05	16.00	13.10	7.00	11.00	9.50
1873	11.00	18.00	14.80	6.50	9.37	7.90
1874	13.75	24.75	18.35	8.20	15.50	11.50
1875	17.70	23.50	20.20	11.80	15.75	13.30
1876	15.20	22.75	18.65	9.35	13.85	11.25
1877	11.40	17.95	14.05	7.55	11.55	9.10
1878	6.05	11.45	8.80	5.32	7.50	6.42
1879	7.30	13.75	9.85	5.32	7.85	6.22
1880	9.40	19.00	13.15	6.35	8.75	7.25
1881	12.50	20.00	16.55	8.37	13.00	10.30
1882	16.00	24.75	19.30	10.05	13.10	11.65
1883	13.20	20.15	15.30	7.15	12.10	9.65
1884	10.55	19.50	16.05	6.45	10.00	7.35
1885	8.00	13.25	10.40	5.82	7.10	6.47
1886	8.20	12.35	9.80	5.82	7.50	6.22
1887	11.60	24.00	15.95	6.20	7.92	7.05
1888	12.90	16.00	14.10	7.25	11.20	9.25
1889	8.35	13.37	11.00	5.75	7.55	6.50
1890	7.50	13.62	10.60	5.50	6.52	6.00
1891	7.45	13.00	10.25	5.47	7.05	6.25
1892	9.35	15.05	11.35	6.05	10.60	6.95
1893	10.25	21.80	17.30	6.37	13.20	9.85
1894	10.67	14.57	12.50	6.45	9.05	7.45
1895	7.50	12.87	10.25	5.15	7.17	6.25
1896	5.50	10.85	7.50	3.05	5.85	4.35
1897	7.15	9.00	8.00	3.42	4.90	4.15
1898	7.65	12.30	9.45	4.62	6.82	5.25
1899	7.85	10.45	8.70	4.90	5.77	5.35
1900	10.35	16.00	11.70	5.65	7.40	6.65
1901	12.60	16.80	14.60	6.90	10.25	8.40
1902	15.00	18.70	16.25	9.07	11.60	10.25

RELATIVE COST OF HOG PRODUCTS.

The following figures and comments by the Cincinnati Price Current form an interesting and instructive study of the relation between the cost of hogs on the hoof and the dressed product:

It is impracticable to compile a table indicating the relative value of leading articles of hog products on the basis of cost of hogs which would be a permanent guide in these particulars, owing to the changes frequently occurring in the relation of these values, as well as some variation in the proportions of product made. On March 1, 1903, Chicago prices were about $9.60 per 100 pounds for green sides, $8.30 for green shoulders, $10.65 for green hams, and $9.70 for lard in tierces. On this basis, calculating sides at 36 per cent, shoulders 10 per cent, hams 11 per cent, and lard 14 per cent of live weight of hogs, and that the remainder of the product, or offal, covers the cost of manufacture, these values represent $6.76 per 100 pounds for hogs alive, and relatively for the various prices stated for hogs, as shown in

the following compilation, * * * indicating cost of green sides, shoulders, and hams, lard in tierces per 100 pounds, and mess pork per barrel:

Relation between prices per 100 pounds of live hogs and of the dressed products.

Hogs, alive.	Sides, green.	Shoulders, green.	Hams, green.	Lard, in tierces.	Pork, in barrels.
$3.00	$4.25	$3.68	$4.72	$4.48	$8.74
3.25	4.60	3.99	5.11	4.83	9.39
3.50	4.96	4.30	5.50	5.38	10.04
3.75	5.31	4.61	5.89	5.53	10.69
4.00	5.67	4.91	6.29	5.88	11.34
4.25	6.02	5.22	6.68	6.23	11.99
4.50	6.38	5.52	7.08	6.57	12.64
4.75	6.73	5.83	7.47	6.92	13.29
5.00	7.09	6.13	7.87	7.26	13.93
5.25	7.44	6.44	7.26	7.61	14.58
5.50	7.80	6.75	7.65	7.95	15.23
5.75	8.15	7.06	8.04	8.30	15.88
6.00	8.51	7.36	9.44	8.64	16.52
6.25	8.86	7.67	9.83	8.99	17.17
6.50	9.22	7.98	10.22	9.33	17.82
6.75	9.57	8.29	10.61	9.78	18.47
7.00	9.93	8.59	11.01	10.02	19.11
7.25	10.28	8.90	11.40	10.37	19.76
7.50	10.64	9.21	11.80	10.72	20.41
7.75	10.99	9.51	12.19	11.06	21.06
8.00	11.35	9.82	12.59	11.41	21.70
8.25	11.70	10.13	12.98	11.75	22.35
8.50	12.05	10.44	13.37	12.10	23.00

In order to indicate the relative value of hogs at a stated price for mess pork and green sides, on the basis of values in Chicago on March 1, 1903, as mentioned, the following is submitted:

Relative value per 100 pounds of dressed product and live hogs.

Pork.	Hogs.	Pork.	Hogs.	Pork.	Hogs.
$7.00	$2.32	$11.50	$4.05	$16.00	$5.80
7.50	2.51	12.00	4.25	16.50	5.79
8.00	2.70	12.50	4.44	17.00	6.18
8.50	2.89	13.00	4.64	17.50	6.37
9.00	3.09	13.50	4.83	18.00	6.57
9.50	3.28	14.00	5.02	18.50	6.76
10.00	3.48	14.50	5.21	19.00	6.96
10.50	3.67	15.00	5.41	19.50	7.15
11.00	3.86	15.50	5.60	20.00	7.34
Sides.	**Hogs.**	**Sides.**	**Hogs.**	**Sides.**	**Hogs.**
$3.50	$2.47	$5.75	$4.05	$8.00	$5.64
3.75	2.65	6.00	4.23	8.25	5.82
4.00	2.82	6.25	4.40	8.50	6.00
4.25	3.00	6.50	4.58	8.75	6.17
4.50	3.17	6.75	4.75	9.00	6.34
4.75	3.35	7.00	4.93	9.25	6.51
5.00	3.52	7.25	5.10	9.50	6.69
5.25	3.70	7.50	5.28	9.75	6.87
5.50	3.87	7.75	5.46	10.00	7.05

To illustrate the changes through variation in relative values of different articles of product, the following is presented as showing figures for the dates mentioned, on the basis of $5 for hogs:

Value of hog products with live hogs at $5 per 100 pounds, 1889 to 1902.

[Cincinnati Price Current.]

March 1—	Green sides.	Shoulders.	Hams.	Lard.	Pork
1889	$6.60	$5.60	$9.47	$7.62	$13.5
1890	6.25	5.35	10.74	7.73	12.6
1891	6.51	5.00	9.87	8.00	13.1
1892	6.61	5.81	9.47	7.42	13.2
1893	6.48	6.15	8.42	8.33	12.9
1894	6.52	6.08	9.24	7.63	12.9
1895	6.39	5.75	9.50	8.01	12.6
1896	6.54	6.07	10.04	6.97	12.6
1897	6.21	6.44	12.12	5.91	12.3
1898	6.74	6.40	9.26	6.78	13.1
1899	6.56	5.83	9.48	7.53	12.9
1900	6.50	6.79	10.18	6.44	12.8
1901	6.83	6.23	8.48	7.33	13.4
1902	6.94	5.83	7.98	7.72	13.4

PORK PACKING IN CANADA.

Prior to two years ago pork-packing operations in Canada had steadily increased for a number of years. During the past two years there has been a decline in this industry in the Dominion.

Official returns of the number of hogs reported on farms on July 1 are published yearly by the Province of Ontario, which furnishes the largest proportion of supplies. The following are yearly comparisons for Ontario:

Hogs in Ontario.

[Cincinnati Price Current.]

Year.	Over 1 year.	Under 1 year.	Total
1893	220,396	791,626	1,012,022
1894	227,878	914,255	1,142,133
1895	244,185	1,054,887	1,299,072
1896	243,756	1,025,875	1,269,631
1897	235,479	1,049,484	1,284,963
1898	267,048	1,375,739	1,642,787
1899	295,349	1,675,721	1,971,070
1900	265,457	1,506,184	1,771,641
1901	222,916	1,268,939	1,491,855
1902	238,992	1,445,643	1,684,635

The number of hogs sold or slaughtered in Ontario for years ending June 30 are officially stated as follows:

Hogs killed in Ontario.

[Cincinnati Price Current.]

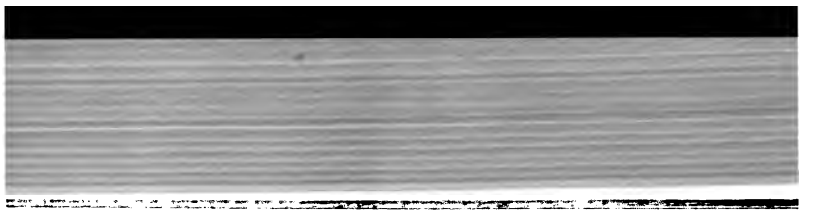
	Number.
1897	1,399,967
1898	1,592,679
1899	1,875,466
1900	2,056,049
1901	1,973,405
1902	1,991,907

Information obtained by the Cincinnati Price Current indicates the following as the number of hogs packed in Canada for the eight summer-season months (March 1 to November 1), the four winter months (November 1 to March 1), and total for the year ending March 1, 1875–76 to 1901–02:

Hogs packed in Canada.

[Cincinnati Price Current.]

Year.	Summer.	Winter.	Twelve months.
	Number.	*Number.*	*Number.*
1902–03	600,000	400,000	1,000,000
1901–02	580,000	390,000	970,000
1900–01	710,000	450,000	1,160,000
1899–00	877,042	614,001	1,491,043
1898–99	725,000	500,000	1,225,000
1897–98	500,000	400,000	900,000
1896–97	450,000	350,000	800,000
1895–96	400,000	350,000	750,000
1894–95	209,010	301,640	510,650
1893–94	142,550	279,920	422,470
1892–93	128,611	227,409	356,020
1891–92	99,466	251,088	350,554
1890–91	91,910	234,970	326,880
1889–90	69,436	169,273	238,709
1888–89	35,343	143,137	178,480
1887–88	70,540	145,674	216,214
1886–87	84,811	171,474	256,285
1885–86	65,230	126,660	191,890
1884–85	55,573	154,575	210,148
1883–84	37,684	99,944	137,628
1882–83	28,715	140,814	169,529
1881–82	57,016	129,971	186,987
1880–81	37,857	156,763	194,620
1879–80	37,447	157,932	195,379
1878–79	8,579	115,775	124,354
1877–78	12,957	151,781	164,738
1876–77	58,544	186,198	244,742
1875–76	25,000	119,989	144,989



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IN ARGENTINA.

One hundred and sixty-two miles southwest of Buenos Aires.

U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF ANIMAL INDUSTRY—Bulletin No. 48.

D. E. SALMON, D. V. M., Chief of Bureau.

THE ANIMAL INDUSTRY OF ARGENTINA.

BY

FRANK W. BICKNELL,

Special Agent and Agricultural Explorer.

WASHINGTON:

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
Washington, D. C., July 8, 1903.

SIR: I have the honor to transmit herewith the manuscript of a paper entitled "The Animal Industry of Argentina," by Frank W. Bicknell, special agent and agricultural explorer.

Mr. Bicknell shows the status of the animal industry of Argentina at this time, and dwells upon the prospects of that Republic as a market for purebred animals from the United States. Some excellent photographs of the cattle, sheep, and horses now being produced in that country accompany the paper.

The subject-matter of this paper is such as will go far toward answering the many requests that come to the Department of Agriculture for information regarding the animal industry of Argentina, and I recommend that it be published as a bulletin of the Bureau of Animal Industry series.

Respectfully,

D. E. SALMON, *Chief of Bureau.*

Hon. JAMES WILSON, *Secretary.*

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ARGENTINE TERMS AND MEASURES USED.

Money.—Unless otherwise stated, all expressions of value used herein refer to Argentine paper money, which will cost the foreigner to-day (May, 1903) 44 cents of United States money for the peso (dollar). The valuations in the custom-house, in which the amounts of imports and exports are stated, are in Argentine gold, worth 96.5 United States money for the peso.

Metric ton, used in the customs statistics.—2,204.62 pounds.

Kilo.—2.2046 pounds.

Liter.—1.0567 quarts, or 0.264 gallon.

Hectoliter.—2.837 bushels, dry measure, or 26.417 gallons, liquid measure.

Hectare of land.—2.47 acres.

Square of land.—4.17 acres.

League of land.—6,672 acres.

Meter.—39.37 inches.

Kilometer.—0.621 mile.

Estancia.—A stock farm, generally very large, where breeding steers and wethers for market, and sometimes also breeding purebred animals for sale as breeding animals, are carried on.

Estanciero.—The man who owns an estancia.

Cabaña.—An establishment where breeding animals are raised for sale.

Cabañero.—The man who owns a cabaña.

Camp.—The term generally applied to the country, the rural part, derived, no doubt, from the Spanish word "campo," meaning the country. People in town say "I am going to the camp," instead of saying "I am going to the country."

Inside camp.—The better and more cultivated and favorably situated land and pastures; usually applied to the better portions of the province of Buenos Aires.

Outside camp.—The more distant, less fertile, dryer and less valuable part of the grazing country.

Mestizo.—Graded animals—partly pure-blooded, of any sort.

Novillos.—Steers.

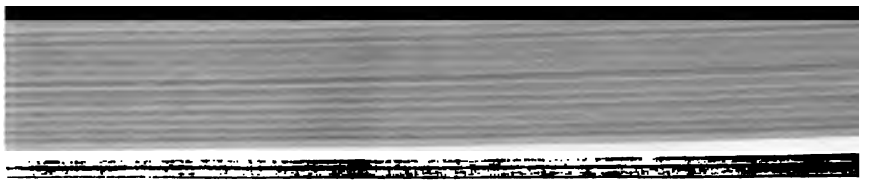
Embarcadero.—The yards and sheds in the port of Buenos Aires where imported animals are received and where export animals are inspected and dispatched on board ship.

Frigorifico.—Frozen-meat establishment.

Lecheria.—Either a milk depot in the city for the sale of milk at retail or the establishment of a milk dealer in the country.

Puchero.—The national dish, especially for the poorer classes. It consists generally of beef, potatoes, and whatever other vegetables may be had. It is all boiled together in one dish and is served in the same manner, requiring few dishes. Some kind of squash is a favorite addition and sometimes chicken is added or substituted for beef. Occasionally a little pork is put in. If good meat is used and it is well cooked and not too much water used, it is very palatable and nourishing. The better families make it with chicken, well flavored, and the chicken and vegetables are served separately.

Chacarero.—A farmer—a man who tills the land and raises a crop on a chacra, or farm.



THE ANIMAL INDUSTRY OF ARGENTINA.

By FRANK W. BICKNELL,
Special Agent and Agricultural Explorer.

INTRODUCTION.

The Argentine Republic is not to be studied hastily if reliable information is expected. Many mistaken ideas of the country have been promulgated by those who have spoken or written from imperfect knowledge or from hasty surface observations. It is difficult to obtain complete or accurate information regarding any resource or industry. Neither Government officials nor the people engaged in any kind of business have collected and published complete and exact reports concerning what is being done or may be done in the country. One can never be sure to what extent statistics have been "estimated," and the operation of comparing and analyzing a part of these reports is likely to reveal flaws that raise doubts as to the reliability of the whole. So the independent investigator, desiring to prove all things—to take nothing for granted and to state nothing of which he is himself in doubt—must get as many facts, estimates, and opinions as possible, and then, adding his own observations and knowledge, be prepared to judge of the value of what he has heard and read and to form his own conclusions. This is the policy which was adopted by the writer in his investigations in Argentina during parts of the years 1902 and 1903—something over a year altogether. This brief account of some phases of the live-stock industry in the great, rich Republic of the south is conservative rather than enthusiastic, and the statements made herein have been carefully verified.

The first object of this inquiry was to determine whether or not the breeders of pure-blooded stock in the United States could sell animals in Argentina. That question may be answered positively in the affirmative, providing the conditions here set forth are studied and observed and only first-class animals are sent to the Argentine sales. If some good Shorthorn bulls and cows could arrive in Buenos Aires from about the 1st to the 20th of August, so they could pass the required forty days in quarantine and be ready to be shown at the time of the great annual stock show and sales in the latter part of

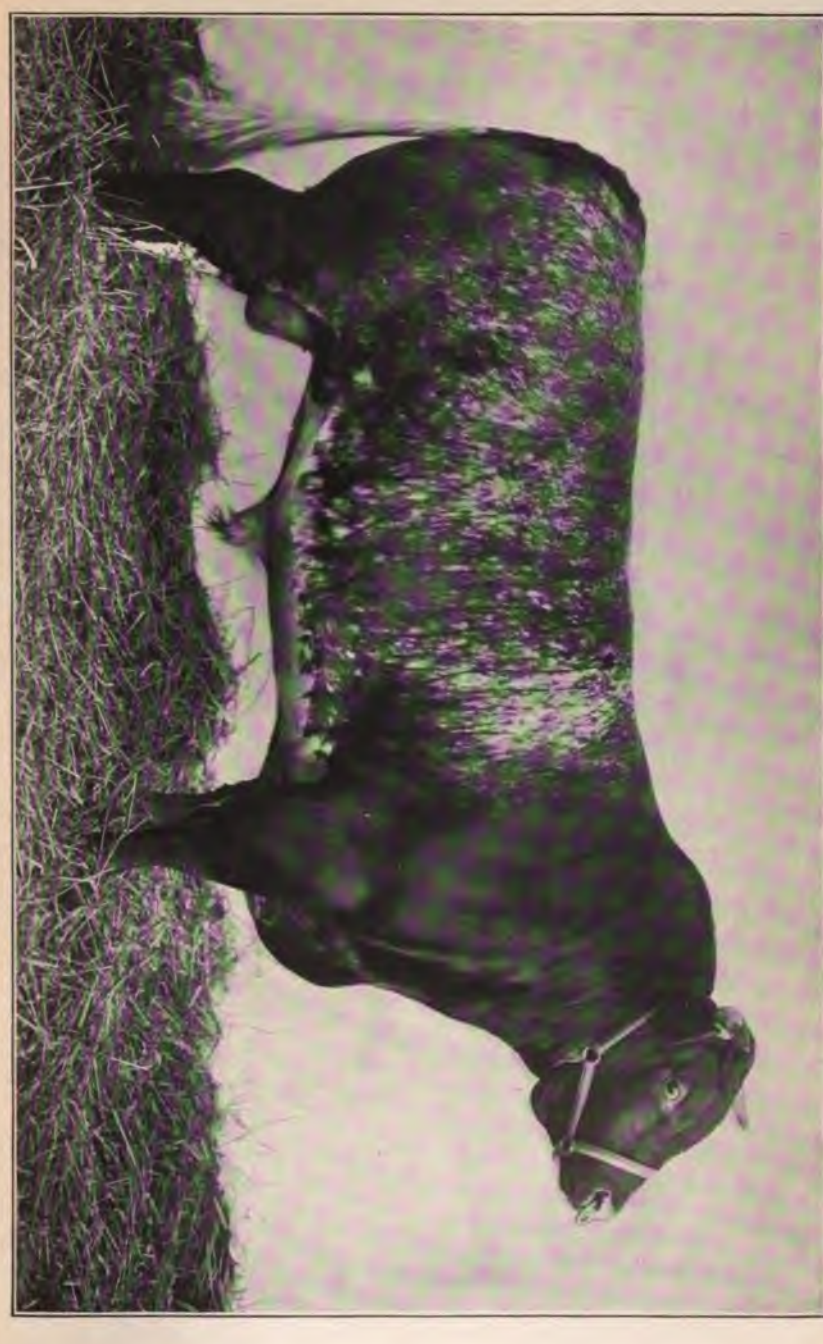
September and the first of October, there is little doubt that the returns would be quite satisfactory to those who sent them.

Because this country is a long distance from the United States and the people strange to us, we should not be frightened and hesitate to reach out for a business that is so simple and that has earned such handsome profits for others. There is nothing to fear in taking stock to Argentina to sell if the animals are right. They should without fail be tested for tuberculosis before leaving home, for they will be subjected to the tuberculin test there at the end of the forty days' quarantine, and, if they react, showing that they have the disease, they will have to be slaughtered or removed from the country immediately. The English breeders who send animals to Argentina do not generally do this. Our Government certificate showing freedom from tuberculosis would therefore add to the value of the animals.

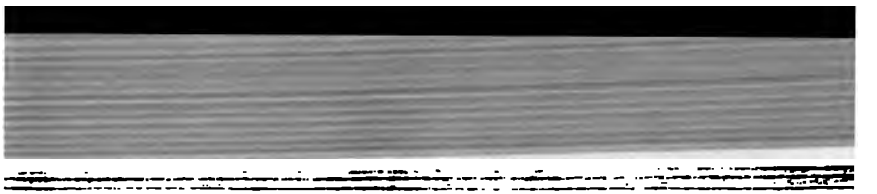
There is no prejudice against any North American in Argentina that is worth taking into consideration in any business enterprise. Any man from the United States who has something to sell that pleases the people there will be well received, and he has as good a chance to sell it as any other man from any other country, providing that he knows the conditions as well as the other man and conforms to them. These things he must learn. To sell breeding stock he will have no trouble if the animals are the right sort, for good breeding stock is keenly sought after, and the supply is inadequate. The Argentines would be very glad to see us enter more into competition with the English and others in respect of their trade, and we may do so very profitably and safely if we study the conditions and observe them in what we do. The writer met with a very cordial reception among Argentines, and has to acknowledge many courtesies. He found them, as well as the English farmers and stock raisers, who are very strong there, always willing to give information. They show a lively interest in us and admiration for our development.

THE ARGENTINE RURAL SOCIETY.

The first Argentine Rural Society (Sociedad Rural Argentino), the progenitor of the present organization bearing that name, had its origin in 1857. The prime mover in putting the idea into effect has told the writer the story of the inception and development of this, probably the most important, organization in Argentina. Like many other good things in Argentina, it had its inception in England. Don Eduardo Olivera, then a student in London, attending the lectures of John Nesbit on agricultural chemistry, noticed in a Buenos Aires newspaper an article by Domingo Faustino Sarmiento, afterwards President of the Republic and also the man who introduced the North American teachers to Argentina, commending a letter the young



LORD WENLOCK, FIRST-PRIZE 3½-YEAR-OLD SHORTHORN BULL. SOLD FOR $6,000.



LADAS 6TH, FIRST-PRIZE 2½-YEAR-OLD SHORTHORN BULL, AND CHAMPION OF SHORTHORNS. SOLD FOR $10,300.

man had written to his father describing the agricultural show in Birmingham. The Argentines were advised to avail themselves of the benefits of like organizations, and this led to the organization the following year of the first agricultural show in the country—a very small affair, under the presidency of Gervasio A. Posadas. During the show a meeting of estancieros[a] was held and a committee named to form a rural society. This committee consisted of Señores Posadas, Sarmiento, Olivera, Favier, and Clark. But civil war came on, and the committee never met. It was not until July, 1866, that fourteen breeders met in Buenos Aires and organized the present Rural Society. The provisional committee was José Martinez de Hoz, Eduardo Olivera, and Ramon Viton. The rules and plan for the society, which had been prepared in 1858 by Señor Olivera, were the basis of the permanent organization, which was perfected a month later (August, 1866) with forty-seven members. The chief objects of the society, as then set forth, were the following:

(1) To promote by all possible means the improvement of our stock in a rational way, based upon scientific experience.

(2) To study the best means of irrigating our dry camps, as well as to drain swamps.

(3) To promote the morality and well-being of our camp population.

(4) To study the best breeds of cattle and sheep abroad, with the purpose of improving, by importation of breeding animals, the stock we now possess.

(5) To search for and study scientific methods adapted to the conditions of our country and calculated to increase our agricultural output.

(6) To secure commercial relations with foreign countries, in order to exchange produce and create a market for ours abroad.

To assist in carrying out these purposes, it was deemed necessary to secure rational teaching of agriculture and to establish an agricultural museum to display national products, soils, etc., and also foreign produce of a similar nature, to serve as models. Practical tests of the most improved machinery were provided for. The museum was founded under the presidency of Señor Olivera, and later has been reorganized as the Industrial Club, its scope greatly enlarged, and made a very important factor in the industrial development of the country, maintaining, as it does, a permanent exposition of national products in Buenos Aires.

The first pretentious show of the Rural Society was held in Palermo, a suburb of Buenos Aires, in 1875. The officers and their friends—those personally engaged in the venture—had great difficulty in getting any animals to exhibit. Very few seemed to take much interest in the show. Only 18 cattle, 19 sheep, and 19 horses were exhibited. In fact, it was not until 1895 that the show assumed national and noteworthy importance. Its development since then has been rapid, steady, and sure, except as regards sheep, with which there have been

[a] *See page 5 for* explanation of this and other terms.

fluctuations. The following comparison of the number of animals exhibited since 1895 shows the development of the exposition:

Number of cattle, horses, and sheep, and value of sales at the expositions of the Rural Society, 1895 to 1902.

Year.	Cattle.	Horses.	Sheep.	Sales.
1895	258	84	581	$120,000
1896	497	91	1,738	300,000
1897	654	116	2,000	335,000
1898	942	265	1,157	600,000
1899	1,457	191	2,204	300,000
1900	1,736	271	2,000	995,000
1901	1,861	249	1,800	924,000
1902	2,008	314	1,718	1,291,797

Besides these, other sales are held every year, at various other fairs in other parts of the country, usually in August, September, and October. Last year an exposition similar to the one in Buenos Aires was held in Rosario, and, for the first effort, was remarkably successful. The sales were small, because at that time the crop outlook was very uncertain; pastures had suffered from frost and drought in the country tributary to that show, and estancieros were avoiding every possible expenditure. The rains came and the prospect brightened very much, however, before the Palermo show in Buenos Aires was held; so the sales there were good.

Various fairs are held in the province of Buenos Aires, some of them under the auspices of societies and some by auctioneers for the sale of live stock—both breeding stock and stock cattle, fattened or to be fattened, and sheep. Then, there are the sales held in the auction houses in Buenos Aires, which are very important to breeders, for here are brought together representatives of the best herds and flocks in the country and also the best imported animals. This year all the imported animals, which are already arriving from England, will be sold in these great auction marts.

The next show, to be held in September and October, 1903, will be a national show, where only those animals bred in the country will be admitted, either for exhibition or sale, unless owned by Argentines at the present time (May, 1903). All imported stock will therefore be sold in the auction marts in the city. Next year (1904) the show will probably be international, foreign-bred animals being admitted. Both before and after the show, every year, sales are in progress in these marts. Two of them are a block in depth, opening on two streets in the business center and have large, airy, clean stalls and auction rings, where the animals are well cared for and shown to the best advantage. Sales of rams are held here at the time of the September-October show, and again in January, and then, beginning in March, for

several weeks. In January of this year 383 rams were sold in one sale. The September-October sales are always best, however. Nearly all kinds of live stock are sold at auction in this country.

Until the organization of the national department of agriculture, about four years ago, the Rural Society exerted a tremendous influence upon legislation and all regulations affecting the stock and agricultural interests, especially the former. It is composed mostly of wealthy and influential men, most of whom live at least a large part of the year in the city of Buenos Aires. They are owners of hundreds of thousands of acres of the best land in the Republic and are chiefly interested in stock raising. The influence of the Rural Society is still very great, and it is extending its usefulness by trying to interest and benefit the agricultural class, even the small colonist. The first agricultural show proper was held in May of this year, and it was the aim of the management to make it similar to our great agricultural fairs. For a number of years the society has held a show at this time for the exhibition of fat stock and horses only.

The Rural Society affiliates to a certain extent with similar organizations in other provinces, and a delegate is appointed to represent the Rural Society in each of these. There are eight of these provincial societies, most of which publish monthly bulletins, and several local or district societies in the province of Buenos Aires that hold local fairs and sales.

They are beginning to learn in Argentina what their big fertile country can do for them, and where and how to make the best of it. They lack agricultural literature and periodicals, such as we have, because the scientific study of agriculture is only just beginning, and because the farmers (called chacareros, as distinguished from estancieros, or stock raisers), the men who are raising crops, are mostly foreigners, many of them unable and unwilling to read. Of course, there are many proprietors (owners of land on a large scale) and a few small farmers who are eager for the best information to be had. For the benefit of these the Rural Society publishes a monthly review, or bulletin, of 60 to 100 pages, containing the best information obtainable regarding agricultural and stock-raising matters, with market conditions the world over, and such statistical information as may be had. The Rural Society in Rosario also publishes a monthly bulletin, and so do some of the other rural societies. The ministry of agriculture publishes, besides numerous special bulletins and reports, a semimonthly bulletin covering the whole field of agriculture, stock raising, forestry, etc., which is quite exhaustive. The newspapers give considerable attention to live stock and agriculture. One English daily has a page on Sunday given wholly to these subjects. The English estancieros have done much for the country by adopting improved methods, and they are all students of agricultural and live-stock litera-

ture. Periodicals and books, and especially the publications of the United States Department of Agriculture, are eagerly seized upon by the energetic, progressive English, and by many native Argentines of Latin blood who have learned English and desire to profit by our experience and study.

THE GREAT ANNUAL STOCK SHOW.

All Argentine breeders, or at least 95 per cent of them, look forward to the annual show of breeding stock, given by the Argentine Rural Society in September and October in Buenos Aires, as the time when they will sell the animals they have raised for other breeders or for estancieros and secure new blood for their herds. The show is a great national stock exchange, where the breeders bring what they have to offer and come to see what others have done, and the estancieros, the producers of beef and mutton and wool and horses, come to buy "reproductores" to supply their large needs; so there are buyers for all classes of animals. The cabañero, or breeder of pedigreed animals, looks only for the best, and is willing to pay fancy and practically unlimited prices for animals that meet his ideas of perfection. The estanciero, or producer of beef, mutton, and wool, looks only, as a rule, for animals of individual merit for his own use in the camp, and he does not care for pedigree. He is contented with a grade bull that he can buy at $200 to $1,000. The same is true of the sheep and horses shown in the exposition, as it will be noticed that many well-bred mestizos, or graded animals, sold for good prices in cattle and sheep and poor prices in horses.

The opening of the fair is a gala occasion. The President of the Republic always attends and the minister of agriculture delivers an address, as well as the president of the society. The speech of the latter, made at the opening of the exposition in September, 1902, contained some rather remarkable suggestions, as he is a firm friend of England, and has been much gratified by having been made an honorary member of the Royal Agricultural Society of Great Britain. This gentleman, Dr. E. Ramos Mexia, was formerly minister of agriculture and a member of the Argentine Congress, where he advocated the passage of a law requiring the modification of the tuberculin test of cattle for tuberculosis, in that animals not far advanced in the disease should not be slaughtered on arrival in the country, but should be branded so they could be known and kept apart from others. But this proposition was defeated and the disposition of animals found to be affected with tuberculosis under the tuberculin test was left, in the order putting the law into effect, to the determination of the executive. This decree orders the destruction of the animals or their immediate shipment out of the country. Dr. Ramos Mexia has published a pamphlet on the subject in the English language, in which he gives

his speeches in Congress sustaining his contentions. The work is dedicated to the Royal Agricultural Society of England.

After the first week of the fair much of the best stock is removed. The attendance is not large at any time—only a few hundred men being present, except on a few afternoons, when the ladies come. The show has been and is yet, to a large extent, for rich men—those doing business on a large scale. The small farmers and stock raisers do not come to see it. It is in no sense a fair like our great State fairs. This year they are organizing for the first time an agricultural fair, to be combined with the fat-stock show this month (May, 1903), in which they hope to interest a greater number of small proprietors. The admission fee at the exposition is at first $2 and is gradually reduced to 50 cents during the second week.

The visitor, fresh from the United States, with indefinite ideas about "the wild cattle on the pampas of the Argentine Republic" is astonished to land here, pass through this great, modern, healthy city of 876,000 people, past its beautiful, well-kept parks to the well-equipped and admirably arranged grounds of the Argentine Rural Society, and there find the greatest collection of purebred cattle and sheep that he ever saw. The grounds are beautiful, and the buildings and stalls for animals are very well arranged and spacious. The location is in a suburb of the city called Palermo, near the finest park in the city.

The new feature of this year's show was the dairy exhibit, the first one the society has given. This was demanded by the lively interest in that industry now being manifested in the country, and this exhibit attracted more attention from the people than any other part of the show. A very large building was supplied with power, and all sorts of dairy machinery was shown in operation. The United States was not well represented in this exhibit, but our manufacturers might do well there.

Very little interest is taken in hogs in Argentina, as their absence from the exposition shows. It is quite safe to predict that some day pork will be one of the chief sources of Argentine wealth, but at present the business of hog raising is out of favor, though the products of the hog, when properly prepared, bring high prices. The chief obstacle seems to be the lack of a reliable market at this time for a large production, and the high taxes and great amount of inspection that accompany the marketing of pork. Argentina once had a good market in Brazil, but that was lost by the degeneration of the pork owing to the feeding of pigs on decayed animals and other offal. When the system of feeding corn to animals is adopted, and large packing houses assure producers of a steady market, the hog business will come up in Argentina, for there appears to be no good reason *why it should not.*

The work of the judges in this exposition is generally done before the show opens. This is always the practice in the fat-stock show in May.

THE ANNUAL SALES OF BREEDING STOCK.

The most significant feature of the stock show in September was the sale of the animals brought there for that purpose; for that, undoubtedly, is the vital thing in the whole enterprise—that which gives it such an attraction for breeders and meat producers. Not an imported animal was sold in the show, and only a few just before. These few were an installment that had been brought from the United States about two years before, and, having left New York the day after the Argentine ports were closed to the United States, were prohibited from entering the country until this time. They were chiefly of Scotch blood and most of them had been imported into the United States and Canada. The highest price got by any of them was $7,400 for a roan 3½ years old. Others sold for $4,900, $4,500, $3,500, $4,450, and so on. One bull, a Cruikshank 4½ years old, was from Danvers, Ill. His age was against him, as it was with all this lot, and he had a bad knee. He has not been sold and is on an estancia owned by the importer. There is no profit in bringing bulls here over 30 months old, and 24 months or thereabouts is better.

In this show in September and October 1,402 cattle, 199 horses, and 924 sheep were sold. The numbers of each exhibited were: Cattle, 2,068; horses, 314, and sheep, 1,718. Six pigs and 31 representatives of the poultry yard were sold, the pigs averaging about $45 each and the poultry $11.

The prices for breeding cattle were generally better than ever before, owing to the lack of any imported stock and to the prosperous outlook for the stock interests and for the country generally. The prices obtained for ordinary camp bulls—not eligible to registration in the herdbook, from grade cows wholly without pedigree—were the most astonishing. These were shown in open pens in lots of from 4 to 10 animals, generally about 8. Of the Shorthorns there were 74 lots, comprising 542 animals, that sold for $214,514, or an average of $395.78. This is equivalent to about $174 United States money. Twelve of these animals sold for more than $1,000 each, the highest being $1,500. Many brought from $600 to $950, and the lowest price was $70, and this for only a few animals. The Shorthorn heifers of the same class did not sell so well, for they were inferior animals. Somewhat over 300 of them were shown, of which 157 were sold at an average of $216.65, the highest being $850 and the lowest $40. These heifers were not considered good animals, or they would have brought good prices. The best heifers are rarely offered at public sale. Comparatively few breeders have cows or heifers to sell, or at least they

do not offer the best of these as they do with their bulls. They keep the heifers for their own use as a rule and sell only the least desirable animals. Breeders are keenly on the lookout for good cows and heifers, and if any are for sale some one in the neighborhood is likely to buy them privately, saving the owner the trouble and expense of taking them to market to be sold at auction. These conditions explain the rather indifferent quality, the comparatively low prices, and small numbers of cows and heifers at the annual stock show.

Taking the prize-winning animals as they come, according to age, we may learn something of the preferences of Argentine breeders and the prices they are willing to pay. It should be remembered that these prices for native bulls were higher than ever before because of the fact stated above that there had been no importations of any consequence for eighteen months.

SHORTHORN BULLS.

Born March 1 to December 31, 1899: (1) Lord Wenlock, roan, bred by Pereyra, sold for $6,000; (2) Boer 137, roan, bred by Pereda, sold for $3,200; (3) Baron 049, red and white, bred by Gimenez Paz, sold for $7,200. Twenty-eight entries, 26 sold, average $2,688; highest $7,200, lowest $1,300.

Born January 1 to June 30, 1900: (1) Ladas 6, roan, champion of the show and winner of special prizes, bred by Thomas Bell, sold for $10,300; (2) Surcouf, roan, bred by Fages, sold for $10,500; (3) Somerville 310, roan, bred by Vivot, sold for $7,000; honorable mention, Mercurio 152, roan, bred by Pereda, sold for $11,100. Nineteen entries, 18 sold, average $3,944; highest $11,100, lowest $750.

Born between July 1 and December 31, 1900: (1) Farrier Bridekirk, red, bred by Pereyra, sold for $11,000; (2) Sultan 12, roan, bred by Villafañe, sold for $4,000; (3) Ulpiano, red, bred by Fages, sold for $5,300; first honorable mention, Stanley 325, red and white, bred by Vivot, sold for $4,200; second honorable mention, Boulevard 062, red, bred by Gimenez Paz, sold for $6,000. Sixty-one entries, 51 sold, average $2,795; highest $11,000, lowest $665.

Born between January 1 and June 30, 1901: (1) Newton Stone, roan, bred by Thomas Bell; (2) Alexandro Beauty 091, roan, bred by Gimenez Paz; (3) Fernando, roan, bred by Aldao. Twenty-three entries, but none of the winners sold; 9 others in the class sold from $1,100 to $5,600, average $1,877.

SHORTHORN COWS.

Born before January 1, 1900: (1) Stella 155, red, bred by José Cobo; (2) Duchess Lily 22, red and white, bred by Anchorena; (3) Celestina 103, roan, bred by Malbran, sold for $2,000. Seven entries, 1 sale.

Born between January 1 and June 30, 1900: (1) Duchess Lily 26, roan, bred by Anchorena; only entry.

Born between July 1, 1900, and March 1, 1901: (1) Calomel 16, roan, bred by Pereyra; (2) Dalia 89, roan, bred by Pereyra; (3) Rosemary, red and white, bred by Cardenas, sold for $2,000. Eight entries, 4 sales at $2,000 each.

HEREFORD BULLS.

Born between March 1 and December 31, 1899: (1) Grandison 42, champion of the breed in the show and also champion of the bulls of the beef races, bred by Villafañe, not sold, and since died; (2) Caronbier 54, bred by Pereda, sold for $2,150; (3) Kaki 63, bred by Pereda, sold for $1,100. Four entries, 2 sales.

Born between January 1 and June 30, 1900: (1) Shamrock, bred by Pereyra; (2) Malmesbury 9, bred by Villafañe, sold for $3,200; (3) Grandison 52, bred by Villafañe, sold for $2,000. Four entries, 3 sales; lowest $800.

Born between July 1 and December 31, 1900: (1) Wonderful, bred by Pereyra; (2) Grandison 15, bred by Villafañe; (3) Grandison 55, bred by Villafañe, sold for $2,500. Fourteen entries; 10 sales at $500 to $2,500, average $925.

Born between January 1 and June 30, 1901: (1) Grandison 63, (2) Grandison 65, and (3) Iron King, all bred by Villafañe, and the 3 sold for $7,000.

Only 1 Hereford cow, born between July 1, 1900, and March 1, 1901, was shown for a prize: Zamora, shown by Pereyra, and given a second prize, and not sold.

OTHER BREEDS.

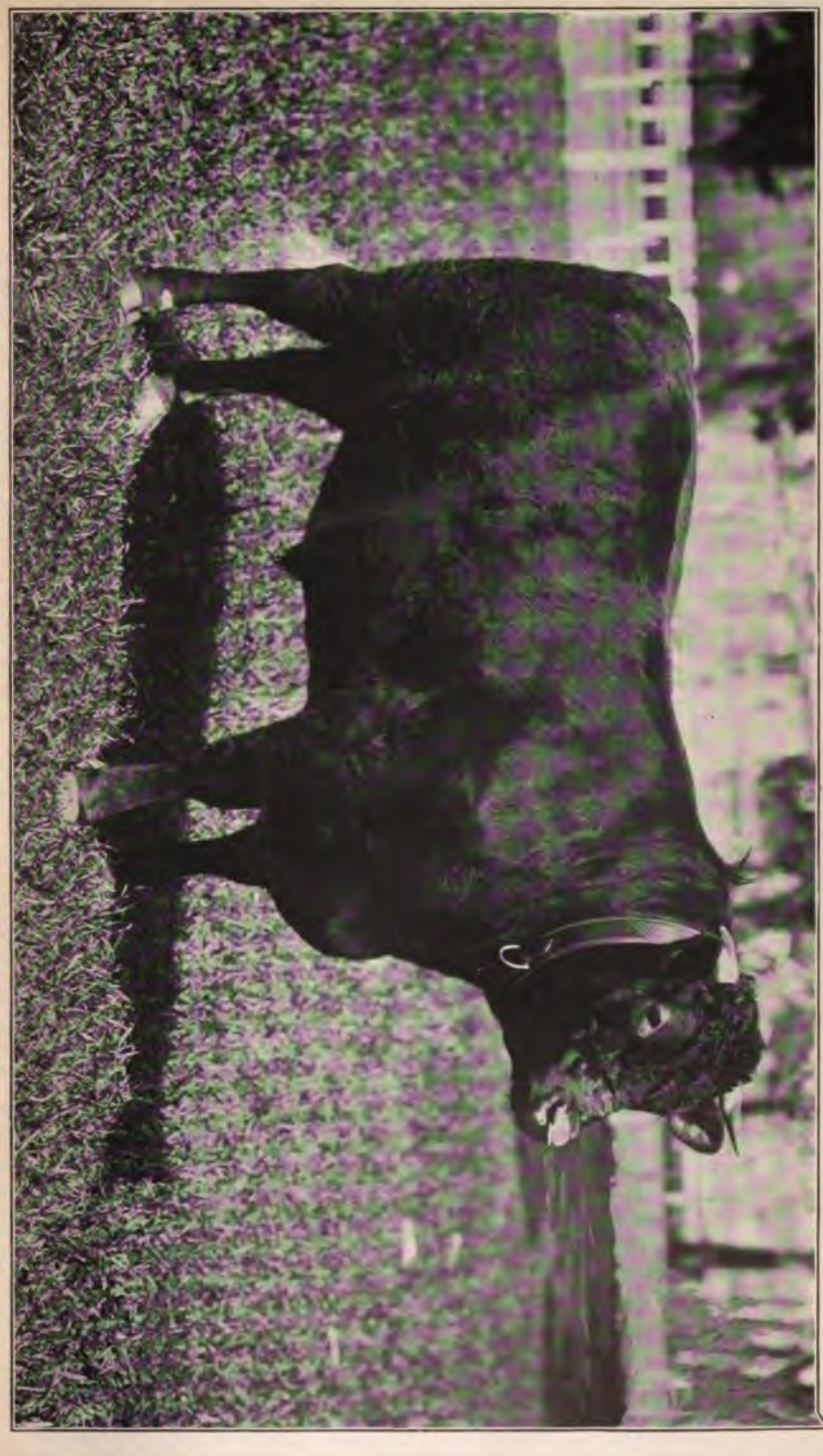
Only 4 Polled Angus bulls were shown for prizes. One was sold for $500 and another went with two 2-year-old cows for $1,300 for the lot. Only 3 Polled Angus cows were shown, the winner of the first prize going with the bull referred to and another cow for $1,300.

A few Holstein bulls were offered, 1 being sold for $1,050 and 2 others for $500 each. Only one prize was awarded, and that to the one that sold for $1,050.

Not a Jersey was to be seen in the show, either for prize or sale. The Jersey herd in Carcarañá, owned by people from the United States who have for years operated a cheese factory there and made it famous, is the only one of any size in the country. Jerseys are regarded as an expensive family luxury and only a few people think of having them, because they do not make beef.

ANIMALS IN GROUPS.

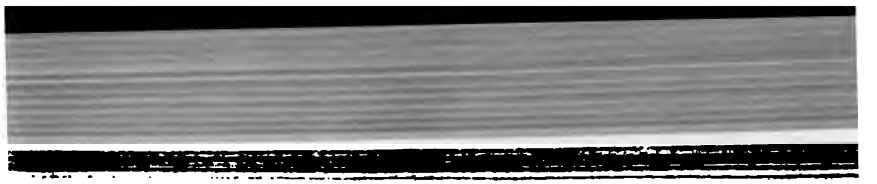
Two groups of Shorthorn bulls of 8 animals each, born in 1900, all registered, the only entries in their classes, sold at $1,000 to $2,100



Farrier Bridekirk, First-prize 2-year-old Shorthorn Bull. Sold for $11,000.

Calomel 16, First-prize 3-year-old Shorthorn Cow.

GRANDISON 42. PRIZE CHAMPION HEREFORD, 31 YEARS OLD.



each, one group averaging $1,375 and the other $1,519. Two groups of Herefords of the same grade sold for averages of $700 and $625, respectively, they being the only entries. Two groups of 8 Hereford heifers, the only entries, sold at an average of $270 and $250, respectively. No Shorthorn heifers were shown in groups for prizes.

GRADE ANIMALS.

Under the head of mestizos, or grades, some very satisfactory sales are recorded, showing the readiness of the Argentine breeder to buy animals on their individual merits, without a recognized pedigree and ineligible to entry in the Argentine herdbook, especially if such animals come from well-known breeders and have been sired by registered bulls. The Shorthorn bulls in this category were shown in groups of 8, and there were 35 entries for prizes, the classification being "Grade Shorthorn bulls of two and four teeth." The group that won the first prize was not sold. The winners of the second prize sold for an average of $1,731, and the third prize group for an average of $1,035. Of the 280 animals entered in this class 218 were sold, the average price being $725. The highest price was $2,600 and the lowest $80, the latter for 2 lots only. All the others sold for $250 or more, generally around $600 to $800, while 58 of these young bulls sold for $1,000 or more. The heifers of the corresponding category sold for less than half, and the best of them were reserved from sale. Of the 120 shown, 56 were sold at an average price of $345. The first and second prize winners were not offered for sale, and the lot that won third prize sold for an average of $734—1 of them for $1,000. These bulls were better animals than those referred to in the beginning of this chapter, the "camp bulls in pen," that sold for an average of $395.78. The latter were rougher animals, raised in the camp, never having had any special care, and most of them were not so well bred as the ones just referred to, which were entered for prizes. But many successful breeders are going in for bulls that have not been pampered, but have grown up under the conditions which they must meet on the average estancia that is not breeding show animals, but is aiming to produce the most beef of the best quality at the least cost. It is often said in Argentina that the ambition to produce show animals has resulted in lowering the vitality of the sires. "What we want," breeders often say, "is a good supply of young, hardy bulls that have been raised to camp conditions, so they can go out with the herd, take things as they come, and keep in good condition while doing their work and without watching and special care."

Only 5 Hereford grade bulls were shown under the class provided for them, and they sold for $450 each. Eight Polled Angus heifers sold for $80 each and 8 Red Lincolns for $130 each.

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ANIMALS FOR SALE ONLY.

Many animals are brought to the exposition for sale only, not being entered for any prize. Under this head 169 purebred Shorthorn bulls were shown, and 127 of them were sold at the average price of $1,270. The highest price was $6,900 and the lowest $250. Four sold for more than $4,000. These were all from one breeder and were sired by the noted bull Spartan. Three sold for less than $4,000 and more than $3,000 and 16 sold for prices between $2,000 and $3,000. Nearly all these bulls were born between June and December, 1900.

Seven purebred Herefords of the same class sold for prices ranging from $550 to $2,000, or an average of $1,191; 3 Polled Angus averaged $423; 3 Holsteins averaged $550; 5 Flemish averaged $1,010; 20 Polled Angus camp-bred grade bulls sold for an average of $210, and 1 lot of heifers for $45 each. But the Polled Angus is gaining, and many well-informed men in Argentina think it will be the second breed in the country—next to the Shorthorn—though now it is very much below the Hereford in numbers.

Among Argentine breeders there are many wealthy men who will cheerfully pay enormous prices for animals that please their fancy, and they frequently do it. Sometimes this results in stimulating prices to an unnatural extent, but it is certain that superior animals will always find admirers and bring prices that average far above those obtained in the United States. It is true that many good bulls are sold privately in the country at lower prices—from $100 to $200—and that there are plenty of native breeders who have not yet learned that it pays to buy a good bull. There are plenty of rough, miserable cattle in the country, but improvement is going on rapidly, as men see that it does not pay to raise poor cattle when on the same amount of land they might be producing good animals and realizing much larger profits. The great increase in the price of land is also leading estancieros to make the most of it, and they can no longer afford to go on in the old loose way, being satisfied with prices of cattle ranging from $20 to $35. They must double or treble these figures, and they are doing it; but they must continue to import new blood to keep their herds up or they will surely degenerate.

SHEEP.

As noted elsewhere, the significant feature of the sheep sales was the decline in the prices obtained for Lincolns, as compared with the sales of 1901, and the gain in prices and number sold of Rambouillets and the Downs. The Merino type is surely in better demand, more general, and not confined to a few breeders. The highest price for a Rambouillet ram in the 1901 show was $7,300, while in this show the highest price was only $2,000. About 70 per cent more animals were sold in 1902, however, and the average was higher. The Hampshire

Downs held their average well up because they were not numerous and there was a good demand for all. Two lambs 3 months old sold for $175 each, which is said to be the record price for Hampshire ram lambs of this age. The sales of Hampshire Downs, Oxford Downs, and Shropshires during the year following this show did not develop big prices, as it appears that the breeders supplied their wants mostly during the show.

HORSES.

The horse sales were not particularly noteworthy, nor, for the most part, were the horses shown. The horse business at present is not at its best, though good horses may be produced here very cheaply. The heavy horses were criticised because they were too heavy and did not show life enough. Some of the light roadsters, the Hackneys, and the saddle horses were very attractive and found many admirers. These, it will be noted, brought the best prices. The highest price in the sale was for a beautiful dapple-gray Percheron, 4 years old, named Docil. He was one of five entries in his class in which three prizes were offered, but he was not considered by the judges to be worthy of a prize. The winner of the first prize was not sold, but the second-prize animal brought $450, while Docil commanded the top price in the whole show. Many other good heavy colts sold for very low prices, which was rather discouraging to the breeders of this class of horses, for some of them were of excellent type and individual qualities. The sales of heavy draft mares was better than in the May show, as they were more uniform and sold for more nearly uniform prices, though rather low as compared with the prices such mares would command elsewhere. But as these were camp-bred animals, the prices were not so low as they seem to the outsider.

The official report of sales made in the exposition is given herewith as it was prepared by the Rural Society. As published, it contained many errors, but some of these have been corrected. It is still incomplete and inaccurate in some respects, however, and, like some other Argentine official statistics, must be taken in a general way—as an approximation and not as an exact statement. For instance, it will be noticed that the average price of heavy "pen" mares is given at $97.97, while the lowest price is said to be $100, when it was really $32. The highest price paid for a heavy stallion is said to have been $2,400, when one was sold for $2,600. But, in a general way, it gives an idea of the sales in a condensed form. The cattle sales, as given in detail in the foregoing account, were worked out by the author of this report independent of this record.

In this statement of sales, "stall" and "pen" are translations of Argentine classifications "galpōn" and "corral," which are used to distinguish animals raised under shelter and with great care from

those raised more or less in the open camp. There is another classification midway between these two, namely, "Criado sistema mixto," meaning, kept part of the time under shelter and part of the time in the open. "Criado á campo" is the expression generally used for an animal that has been raised in the camp altogether.

Condensed statement of sales of live stock in the September-October exposition, Buenos Aires, 1902.

CATTLE.

Breed.		Number exhibited.	Number sold.	Amount of sales.	Highest price.	Lowest price.	Average price
Shorthorns:							
Stall	Male	301	233	$462,016	$11,000	$400	$1,982.90
	Female	19	6	12,000	2,000	2,000	2,000.00
Pen	Male	1,030	790	402,605	2,600	70	509.62
	Female	469	238	55,930	1,000	40	235.00
Total		1,819	1,267	932,551			
Herefords:							
Stall	Male	33	25	35,349	3,200	500	1,415.96
	Female	7					
Pen	Male	41	28	14,870	1,100	170	513.70
	Female	16	16	4,160	270	250	260.00
Total		97	69	54,379			
Polled Angus:							
Stall	Male	8	5	2,250	550	300	450.00
	Female	7	5	1,000	200	200	200.00
Pen	Male	62	20	6,425	430	100	321.25
	Female	29	16	1,000	80	45	62.50
Total		106	46	10,675			
Holsteins:							
Stall and pen	Male	6	4	2,600	1,050	200	475.37
	Female	5					
Total		11	4	2,600			
Flemish:							
Stall and pen	Male	5	5	5,050	1,250	900	1,010.00
	Female	10					
Total		15	5	5,050			
Dutch:							
Stall and pen	Male	3	3	1,400	560	400	466.66
	Female	5					
Total		8	3	1,400			
Red Lincoln:							
Stall and pen	Male	3					
	Female	8	8	1,040	130	130	130.00
Total		11					
Red Polled:							
Pen	Male	1					
Total		2,068	1,402	1,007,695			

Condensed statement of sales of live stock in the September-October exposition, Buenos Aires, 1892—Continued.

HORSES.

Breed.		Number exhibited.	Number sold.	Amount of sales.	Highest price.	Lowest price.	Average price.
Saddle:							
Stall	Male	9	2	$2,050	$1,800	$250	$1,025.00
	Female	1					
Light draft:							
Stall	Male	57	28	23,620	2,050	270	843.57
	Female	1	1	350	350	350	350.00
Pen	Female	52	16	2,080	130	130	130.00
Heavy draft:							
Stall	Male	109	83	54,390	2,400	110	655.30
	Female	7					
Pen	Female	78	69	6,759	155	100	97.97
Total		314	199	89,249			

SHEEP.

Rambouillet	Male	304	213	76,923	2,000	50	361.13
	Female	121	51	3,220	150	40	63.13
Lincoln	Male	832	375	84,371	1,600	35	224.98
	Female	123	84	4,150	210	30	49.40
Shropshire	Male	105	89	8,220	500	40	92.35
	Female	35	5	350	70	70	70.00
Oxfordshire	Male	60	31	6,844	600	50	220.77
	Female	5					
Hampshire	Male	59	31	7,900	600	100	354.83
	Female	74	45	2,250	59	50	50.00
Total		1,718	924	194,228			

MISCELLANEOUS.

Pigs	Male	8	6	280	50	30	46.66
Poultry		136	31	315	50		
Dogs		12					
Grand total for the show		4,256	2,562	1,291,797			

THE HERDBOOKS AND FLOCKBOOKS OF ARGENTINA.

The Rural Society controls all the herdbooks and flockbooks in the country. The Shorthorn herdbook was started about thirty years ago by several breeders and remained a private concern until a little more than two years ago, when it was purchased by the Rural Society. The Hereford herdbook was purchased by this society several years ago, as was also that of the Red Lincolns. The Polled Angus record was started by the society six or seven years ago. There are no rival herdbooks, and the registration in the society's books is recognized everywhere in the country.

There is a commission of three members for each breed. Each member holds office for two years and is eligible for reelection. This commission *passes upon all* applications for registration, and though *an appeal may be taken to the* general board of the society, this has

never been done but once, when the commission was sustained. The commission has power to send inspectors to the "cabaña" (breeding establishment) to verify the claim made in the application for registration, but this also has never been done.

Until now any animal that was entitled to registration in the Coates's herdbook of England was admitted to registration in the "Herdbook Argentina." After a long and spirited discussion the directors of the society decided that hereafter no imported Shorthorn can be registered in the Herdbook Argentina unless the first dam and sire of the same inscribed in the pedigree were recorded prior to the year 1850. The argument used to bring about this restriction, which shuts out many bulls that have been going to Argentina from England, was that so long as the Argentine breeders were not permitted to register grade Shorthorns after many years of crossing and improving, English breeders should not be permitted to register animals of five crosses.

Many breeders are in favor of establishing a second herdbook—a preparatory record—in which should be inscribed graded animals after a certain number of crosses, these animals to be eligible to entry in the regular herdbook after a certain number of additional crosses. But these were outvoted when the recent regulation was made.

The beef producer, he who is thinking only of producing good steers, is not particular about the pedigrees of his bulls. He looks to the individual merits of the bulls he is buying first, then seeks to know what breeder they came from, and, lastly, perhaps, to ascertain what sort of ancestors they had. He wants the bull in order to raise steers and has no use for the pedigree.

There are probably not more than fifty breeders in Argentina who are familiar with pedigrees and families and take these into prime consideration in buying bulls. Until very recently the Argentines were thinking wholly of beef. They prefer deep reds and dark roans because, they say, the lighter colors fade out and look very bad in their country.

The certificate of the recognized herdbook in any country will be recognized in Argentina by the Rural Society, provided the animals presented for registration comply with the conditions stated. The American Shorthorn Herd Book has been recognized there before, and so has the Hereford Register. Between the years 1879 and 1887 many Herefords were brought to Argentina from the United States. The certificates of pedigree must be indorsed by the Argentine consul in the port from which the animals are shipped. Animals must be registered within one year after their birth or importation in the country. The fee for the registration of cattle is $5 for each animal born in the country and $10 for each imported animal for members of the Rural Society and twice these amounts for those not members.

The flockbooks are held in small repute by the sheep breeders; not that they are not perfectly regular and of a high standard, but the breeders as a rule do not think it worth while to register their animals, particularly ewes. Only about half a dozen breeders register regularly. Rams must come prepared to register, in case the certificates should be called for, but frequently buyers do not ask for them, particularly if they know the reputation of the place they came from. If from the United States, the certificates would undoubtedly be demanded. The flockbooks are based on the English requirements, and the fee for registration is $1 for individuals and 50 cents per head where the registration is collective, and double these amounts for imported animals. Nonmembers pay double fees. The registration in the flockbooks is increasing, but it will very likely be slow.

The herdbooks and flockbooks are in charge of a competent Englishman, Mr. H. Bruce Percy, who acts as secretary to all the commissions, and is in personal charge of the office in the Rural Society's building in Buenos Aires.

An arbitration board for the settlement of disputes among the members without going into court is one of the benefits open to the members of the Argentine Rural Society. Disputes between members, or between a member and an outsider, may be submitted to this tribunal, which is composed of some of the best men in the country. But both must agree to submit to the decision of the board, and if a member violates the decision he is expelled and posted in disgrace. This board was started about ten years ago and afterwards abandoned, as very few took much interest in it. About two years ago it was revived, but still it is but little patronized. An effort was then made to make it compulsory for both parties to a dispute, if members of the society, to submit their contention to arbitration, which is free of cost, if either party desired it; but this failed.

WHAT ARGENTINE BREEDERS WANT.

An annual exhibition of breeding stock by the Argentine Rural Society will be held during the latter part of September and the first half of October, 1904. At that time the Rural Society's show will probably be an international one, and imported animals may be shown on the grounds; this is not permitted when the show is only national, as it is this year, and imported animals can not be shown for prizes or admitted to the show grounds. Shipments should be made from New York not later than July 1 to 15.

The English ports were opened to Argentine live stock on February 3, 1903, after having been closed nearly three years. A slight outbreak of foot-and-mouth disease on three estancias caused the Argentine Government to close its ports to export animals on May 9, 1903, pending the eradication of this malady, but this may not last more than

a few months. The Argentine Government now (June, 1903) claims that the disease no longer exists in the country and is at present seeking readmission to British markets for live animals. The three months during which the export trade went on stimulated prices and taught the producers of fat cattle and sheep that they can only hope to compete with the United States by producing the best animals and preparing them in the best possible manner.

The danger of war with Chile appears to be past and capital is being more freely invested in the country. Agricultural and stock-breeding operations are being and will be carried on with more certainty every year, as the conditions are being studied and fewer mistakes are being made; hence greater profits and more money to invest in improvements of all kinds. Last year was a bad time, as much uncertainty prevailed. The markets were limited to the local demands and three freezing plants and one chilled-meat concern, with what could be worked up in the way of live-animal trade in South Africa, Spain, Portugal, and Brazil, all of which was not much. Of course, there were the saladeros (salting establishments), the makers of tasajo (jerked beef), but these showed a heavy falling off during 1902. But now the country exhibits every indication of a boom. The price of country property has advanced 30 per cent within the year, and there is little dissent from the opinion that these values will be maintained. Alfalfa is taking the place of the unproductive wheat fields, and cattle are wanted to eat the alfalfa, though much of it is exported. Two additional chilled-meat establishments are in process of building and others are in prospect, while some of those already in existence are being enlarged. New areas are being opened up at the southwest, new railway lines are in projection both north and south, and all this means a demand for better and more cattle. The same is true of sheep. A change is taking place, as so well told by Mr. Herbert Gibson in a contribution to this report. A demand is felt which the United States can supply—that is, for good mutton sheep.

PREFERENCE FOR SHORTHORNS.

A glance at the report of sales at the last show, given in detail elsewhere, indicates the overwhelming preponderance of Shorthorns in Argentina. Of all the cattle there exhibited (2,067), 1,824 were Shorthorns, and of the total amount of cattle sales ($1,007,695), the Shorthorns brought $932,581. This is a fair indication of the preference of estancieros in the country. The influence of this great majority of Shorthorn breeders is so great that it is difficult to introduce any other breed, and other breeds do not have the same fair chance that they would if they had more supporters. There are, to be sure, many breeders and advocates of the Hereford as an animal of superior hardiness, good health, feeding qualities under adverse conditions, and a

sure breeder. It is generally admitted that the Hereford is better for poor camps than the Shorthorn, and that he is much better able to endure hardship. In most of the tests for fat steers the Hereford has shown a greater percentage of net beef, winning the championship in the May show of the Rural Society for four consecutive years. The objection made to him is that he does not produce a marketable fat steer as soon as the Shorthorn. It is claimed that in the good camps, on alfalfa or the best native grasses, the Shorthorn is ready for market six months sooner and, age for age, produces a heavier, finer-grained animal. So that it is better at this time to take Shorthorns to that market than any other sort of animal.

Argentine breeders have not gone in for any special strain of Shorthorns, except that now the tremendous impetus given to the dairy industry makes the milk strains popular, as, for instance, those of the Bates family. At present the Cruikshank Shorthorns predominate largely. While breeders there will look very carefully to see that the pedigree is all right, they buy on their individual judgment of the merits of animals offered rather than on the certificates of pedigree that go with them. The Shorthorn bulls must be short in the legs, deep and long in the body, with a good head, full, wide chest, well-laid shoulders, strong loins, and well-sprung ribs, covered with deep, mellow flesh, full hind quarters; and his color will please best if it is a deep red or roan, preferably the former. Special stress is laid on the head there. Bulls should be from 2 to 3 years of age, but not less than 18 months old.

DEMAND FOR COWS.

Some first-class Shorthorn cows, especially those known to be good milkers, and heifers of good milking and beef antecedents, will be sure to bring long prices, for they are very much wanted. It was noticeable at the Rural Society's show that the very limited number of cows shown were of inferior quality compared with the bulls. To be sure, breeders do not like to take fine cows to the show, because they must be fattened more than is good for them, and the inducement is not sufficient, as they do not desire to sell them. A good bull may always be had with a fourth of the effort required to find an equally good cow. Notice that while 233 high-grade bulls were sold, only 6 cows were sold in that class. The 238 Shorthorn cows sold were of the corral, or rougher, class, and yet they sold for an average of $235, or $103 United States money. The young bulls of the same class brought an average of $510, or $224 gold, and it must be remembered that a great number of these were not purebred, and so had no pedigree. They were bought wholly on their individual merits, and many of them brought from $1,500 to $2,000. If the cows had been of equal quality they would have brought much more than they did.

These mestizo cows were, in fact, rather inferior, and were the

second or third choice of the herds from which they came. Often they were merely the pick of general camp stock, and most of them had no pedigree whatever.

The uniformity of the exhibits of some of the better breeders was an indication that they were paying more attention to the selection of dams, recognizing the folly of wasting expensive bulls on poor cows. A very good authority on the selling qualities of breeding stock in Argentina says:

> There is a good demand for superior cows, providing they be of conditions to enter the Argentine Herdbook. During the year 1902 all pedigree cows, even inferior and old ones, were sold at very good prices. It is safe to say that there is a buyer for every Shorthorn cow, not necessarily a choice specimen, but of good type and antecedents. Cows to bring top prices here must be strong in the hind quarters; they must have unmistakable beef qualities.

As indicated elsewhere in the reference to the dairy industry, there is a demand for some thoroughly good sires of the dairy breeds, except Jerseys, and a few notably good cows. The Holsteins seem destined to play an important part in the future of the Argentine cattle-breeding industry, and so are the Flemish cattle, neither of which can now be imported into this country from Europe. The strength of the Holsteins in the United States ought to give the breeders of that race a good chance in Argentina.

OTHER BREEDS.

Herefords will not bring high prices there, compared with Shorthorns, though an animal that would command favorable attention, a really great sire, would probably fetch $5,000, equal to $2,200 United States money, or possibly a little more. A criticism that is often made of the Argentine herds other than Shorthorns is the lack of really great individual sires. There are breeders of Herefords, Holsteins, and Aberdeen-Angus who will recognize and buy, regardless of price, bulls of the highest merit, but will not look at an ordinary animal. As the importer of these breeds must look to the best breeders for his customers, he must be able to satisfy them.

The following shows a comparison of the prices obtained for Shorthorns and Herefords for three years past in the Rural Society's sales in October:

Prices of purebred and grade Shorthorns and Herefords, 1900–1902.

Year.	Pedigree Shorthorns.	Pedigree Herefords.	Grade Shorthorns.	Grade Herefords.
1900	$1,789	$895	$447	$362
1901	2,277	1,937	486	475
1902	2,891	1,344	524	297

It is hardly fair to the Herefords to make such a comparison without making allowance for several influences on the prices obtained. In

1901 the Herefords were of a better class than in 1902, though the number of bidders was greater in the latter year. So few animals were presented that one or two high prices paid for individuals in 1901 affected the average. Mr. Eduardo Bullrich, a man well informed on live-stock matters, gives the following opinion concerning Herefords, being the result of years of close observation among breeders and estancieros:

> The Hereford is a breed which, for its adaptability to range conditions, hardy constitution, courage, and perseverance, combined with ideal grazing properties, will make its way in our country as well as any other beef breed, though perhaps slowly.

The Polled Angus is making headway and, though but little known, is giving results that are attracting attention. In a circular letter to estancieros advising them what to breed for the new chilled-beef establishment at La Plata, the manager, Mr. Daniel Kingsland, puts Polled Angus second only to Shorthorns. The breed is well adapted to the fine pasturage of the valuable inside camps, as well as to the rougher regions where its vigorous constitution enables it to thrive under conditions that would interfere with success with Shorthorns. Some magnificent steers have appeared in the export markets from the Polled Angus growers. It would not be wise, however, to bring to this market as an experiment more than one Polled Angus bull.

Some first-class Polled Durham or Red Polled bulls ought to find ready buyers, for they have admirers; and there is a tendency among some breeders to dehorn and to strive to produce hornless cattle. The advantages in shipping and handling are sufficient to pay for considerable effort and expense. Dehorning is not much practiced, however, especially upon grown animals. There is a strong prejudice against it on humanitarian grounds. Some breeders and shippers claim that it is an advantage to have the horns in handling cattle on shipboard.

PROFITS OF IMPORTERS.

About three years ago an English importer bought a fine young dark-roan Shorthorn bull at the Belfast fair in Ireland for £105 ($510.98) and brought it with others to Buenos Aires, where the animals were sold at auction. This young bull, Farrier, attracted the fancy of Señor Leonardo Pereyra, one of the most successful and one of the richest breeders in the country. His estancia, San Juan, is the show place of the country, only an hour's ride from Buenos Aires. Here he has 5 leagues, or nearly 34,000 acres, and in various other parts of the country he owns a total of 80 leagues and many thousand cattle. The San Juan place is the old home place, where his father began the improvement of his stock more than fifty years ago, and is used only for breeding stock. Thirty to forty men are employed to care for the beautiful park which he maintains there. Señor Pereyra breeds Shorthorn and Hereford cattle, Lincoln and Merino sheep, and

various breeds of horses—always winning many prizes at the shows and getting the top prices for the animals he sells.

All this by way of preface to the sale of the handsome roan Shorthorn bull that pleased Señor Pereyra. He pleased others also, so that the price went up to $15,700, or $6,751 United States money, before the other bidders were willing to quit and let Señor Pereyra have the bull. He has always been well pleased with his bargain, for Farrier has given him about 230 fine calves, among them a prize winner this season, a red bull that was second only to one other in the show in the contest for the championship of Shorthorns. This bull sold for $11,000, or more than the champion. In the show were 8 or 10 others of Farrier's sons, of which 4 were sold—for $900, $3,200, and 2 for $4,200, respectively—the total sales of Señor Pereyra from this bull alone being $23,500 in the auction sales in this one show. Others of Farrier's get were reserved from sale.

The tremendous profit realized by the importer of this bull is not a matter of surprise, though a little larger than is often earned. Many bulls are bought in England for £40 and sold in the Argentine spring sales for from $3,000 to $7,000 paper, or from six to fourteen times what they cost in England. Often breeders in Argentina order bulls sent out from England or Scotland on commission; that is, buyers in England, familiar with the country and the wants of the Argentine breeders, especially their clients, attend the English sales and buy on the order of the Argentine breeders, receiving a good commission for their services. This generally results in the English breeder getting better prices for his animals, for the agent of the Argentine breeder knows his client expects to pay a handsome price, and when he finds an animal that he thinks will suit he bids till he gets it. When two or three of these buyers come together, it is a fine thing for the English breeder. Those who buy on speculation on their own account for sale at auction in Argentina look about for good animals, which can be bought cheap and sold on their individual merits; and they are very successful in the business. Only a short time ago the bull Royal Duke was bought on order from the herd of the King of England for an Argentine breeder, Señor Manuel José Cobo, for £800, and the bull, being old and in poor health, died on shipboard, insured for £1,200.

When the Argentine ports were closed to importations from England, a clever English importer went to the United States and bought a lot of bulls, mostly those that had been brought previously from England or Scotland, and started for Buenos Aires with them. Some of his rivals heard of it, and the ports were closed to animals from the States on the representation that he was bringing animals from England to the United States to be reshipped to Buenos Aires. This decree was issued the day before his animals left New York, but no advice was sent to New York, and he sailed in ignorance of it. The result was

that the animals lay in Montevideo for eighteen months or more, until they could be admitted here. A bull named Brave Archer was bought in Chicago for $240 United States money. He had been brought from Scotland about a year before, and though he was a 4-year-old, he sold in Buenos Aires last year for $6,800.

Some recent importations of light-roan Shorthorns from Scotland sold at $1,400 to $2,500, it being the wrong time to offer them, and part of them were withdrawn for later sale. They were not extraordinary animals—some of them being very ordinary—and the prices realized gave the importers a snug profit.

In 1887 some Virginia breeders sent a large consignment of Shorthorns here, and they realized very handsome prices for them, the leading bull bringing $12,000. They enjoyed a good business, but the revolution in 1890 brought it to an end.

HIGH PRICES FOR ORDINARY ANIMALS.

The following recital of the disposition of a certain shipment of cattle is full of suggestion: The shipment consisted of 1 bull, born March 7, 1900, 14 heifers and cows from 2 to 2½ years old, one of them a cow with a young calf, and one 8-months-old calf. Two of the heifers were ineligible for registry in the Argentine herdbook; one of these sold for $600 and the other was withdrawn. The heifer calf 8 months old was sold for $500. The bull was a rather good animal, a deep red, a little rough in shape and faulty in the head, and a trifle faulty in the hind quarters, but in excellent condition, strong, and well developed, and he sold for $3,500. The general comment among those present was that he was a very good bull for breeding steers, but not good enough for a sire of breeding animals. The heifers, with one or two exceptions, were very inferior. They were mostly roans, with two or three reds. They had suffered from long voyages and the unfavorable conditions at Las Palmas, where they spent eight months after having once been rejected at Buenos Aires because they arrived with foot-and-mouth disease. They were very "leggy," a fault quickly to be noticed in Argentina, and most of them were bad in other respects, particularly in the hind quarters. They were all bred to good bulls, and, being young and of good breeding, familiar to the bidders, and brought by a well-known importer, they brought astonishingly good prices. The lowest price was $1,000, the highest $2,000, and the average for 12 was $1,490. They were offered at a very bad season when very few care to buy. If they had been offered at the time of the September show, they would undoubtedly have brought considerably more.

If these animals, which in this country would have been slow sale at $150 to $200 United States money, and might have gone for less, could be sold at an unfavorable time for such good prices, what would be realized for tiptop cows, such as could be sent from the United

States? There is no doubt about there being a good business in taking such excellent animals there. The country is simply hungry for good breeding animals, especially Shorthorns, and cows will be particularly acceptable, because they are badly needed.

FAT-STOCK AND HORSE SHOW.

For several years the Rural Society has given a show in May for horses, fat cattle, and sheep. It is primarily a horse fair, as the sales are chiefly of horses. It is a combination of market and competition for prizes, and many animals are brought to the show to be sold, not being entered for prizes. This show was to be combined with the new agricultural fair this year (see p. 13).

Interest centers in the competition among the Shorthorns for the championship, although for four years prior to 1902 the champion fat steers were Herefords. This is the more remarkable because of the comparatively small number of Herefords bred in the country. In the 1902 show there were twenty lots of 8 steers each competing in the Shorthorn class and only two lots of 8 each in the Hereford, Polled Angus, and Holstein classes. For the Hereford to win under these circumstances, with the great preponderance of opinion against him among the breeders, and hence among the judges, has been a source of much satisfaction to the champions of the breed. In the last show the championship was won by the Shorthorns, but the block test that was made after the award, after the animals were sold and slaughtered by one of the chilled-beef companies, was against the Shorthorns and in favor of the Herefords.

The average weight of the 160 Shorthorns shown, aged about 42 months, was 780 kilos, or 1,719 pounds. They were sold at auction at prices ranging from $110 to $310 per animal, and were bought for export, as all good fat steers were then, by the frozen-meat and chilled-meat establishments. This is equivalent to $48.40 to $136.40 United States money. The average price was $187.75, or $82.61 United States money, or $4.80 per hundredweight live weight. These are extraordinary prices for prize animals, carefully prepared. The lowest weight was 1,531 pounds and the highest 2,008.

The Herefords averaged in weight 1,815 pounds and sold for an average of $200, or $88 United States money. The Polled Angus, with an average weight of 1,318 pounds, sold for an average of $80. The Holsteins showed an average weight of 1,478 pounds and brought an average price of $97.50.

The first-prize Shorthorns, the ones that won the championship of all breeds, weighed an average of 1,931 pounds, and one lot of 8 brought $310 each and the other $270. When slaughtered they dressed out 62.2 per cent of net beef. The second-prize Shorthorns, composed of three lots of 8 each, averaged in weight 1,885 pounds,

and they sold for an average of $207. They dressed out 62.8 per cent of net beef. The third-prize group of Shorthorns were the heaviest, averaging 2,008 pounds, but the animals were marked off by the judges for excess of fat and for other reasons. They were sold privately for $310 each, the same price as the champions. No block test was made of these animals, which were exported alive to South Africa.

The Herefords made a fine showing when slaughtered. The first prize lot weighed an average of 1,821 pounds and sold for $205 each. They dressed out 65.01 per cent of net beef. The second prize Herefords averaged 1,810 pounds and brought $195 apiece, giving 62.75 per cent of dressed beef.

No block tests have been reported on the Polled Angus and Holsteins, but the former were not regarded as exceptionally good animals and no prize was awarded them.

KIND OF CATTLE FOR EXPORT AND HOME CONSUMPTION.

Prior to the opening of the British ports in February, 1903, the best grade Shorthorn steers and other steers that could grade with them were bought for export at $75 to $90 and occasionally a little more for very superior animals. When the English ports were again closed to Argentine live stock (May, 1903), the price for the best grass-fed steers of 3 to 3½ years old, the usual selling age for export, was from $85 to $115. There was a good demand; in fact, more than the supply could meet and maintain its quality for export. Not 5 per cent of these steers had tasted grain, but the majority of them had been fattened on alfalfa and others on native grasses. This quick production and the ease with which such steers are sold has encroached a little more every year upon the reserve supply; that is, younger animals have been sold for export, fewer good steers are killed for home consumption, and more cows, heifers, and calves, as well as inferior steers and oxen, are used to supply the home markets. Thus it is extremely difficult to get a good piece of beef in the city of Buenos Aires. None of the best fat steers—"export type," they are called—are brought to Buenos Aires to be sold, or at least so rarely that the local markets are not looked to for any part of the supply. If a man has a lot of good steers ready for market, he notifies his broker in Buenos Aires, who notifies the buyers, the "frigorificos," and the exporters of live cattle, and the latter send their representatives to inspect the cattle. Then the buyers make bids, either through the inspectors on the spot or through the brokers in the city. Some estancieros get along without brokers and do business directly with the buyers. The prices quoted are for the animals on the estancia, and it costs from $8 to $10 each to bring them to Buenos Aires. The top price of $115 is but rarely paid. The usual price for the best animals is from $100 to $110, and still more are sold to the

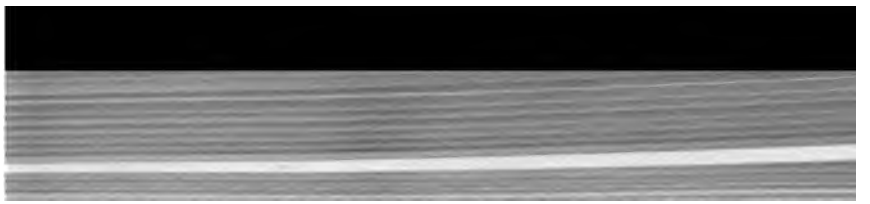
frigorificos at $85 to $100. Now that the English ports are closed again, there is a decline of perhaps 10 or 15 per cent in the prices of the best steers. These animals range in weight from 1,225 to 1,42 pounds, giving a weight of 700 to 800 pounds of net beef, exclusive of head, feet, kidneys, liver, and other fat and offal. The marketabl by-products there are limited and there is much more waste than i the great packing houses in the United States.

The freezing works prefer steers of greater age because of thei greater weight, but there is scarcely a good steer in the country tha is 5 years old that could have been sold younger. Very few are kep beyond 4 years; selling at 3 years or younger is happening oftener and is the general rule. Formerly the selling age was 4½ years Alfalfa has had more to do with getting the animals on the market year younger than any other one cause. Cattle for the export trad are shipped to Buenos Aires, 450 to 750 miles, but the cheaper grade are driven at least a good part of the distance, as they will not stan the freight charges, and it is much cheaper to drive them to market The public roads in Argentina are very wide on this account.

ARGENTINE STEERS ARE GRASS OR ALFALFA FED.

Corn-fed animals are very rarely, almost never, seen. The price paid for steers by the frigorificos, which, until a few months ago furnished, and again at the present time do furnish, almost the only market for good steers, did not warrant any corn feeding. A few years ago, before the English ports were closed to Argentine liv cattle, so-called corn-fed steers brought $5 to $10 per head more tha those that had not received any grain. But these were not really corn fed, for they had received corn and dry hay for a month or so only before being brought to market, and this in order to teach them to ea it on the voyage. They had their accustomed alfalfa or grass pastur during the day and the corn and other dry feed at night. This system may be resumed this winter if the price of corn is lower than it i now. At present producers of fat steers say it would not pay. Corn is now selling for about 35 to 40 cents United States money per American bushel of 56 pounds. It is claimed by many Argentine breeders and feeders that the alfalfa and grass-fed beef is as good a corn-fed beef, but the best-informed ones—those who know the differ ence and have seen both kinds—realize that the Argentine, who would get the best price for his steers in competition with those from the United States, must finish them on corn, and this course is being advo cated by many who predict that this must soon come. It is likely to be a long time, however, before any considerable amount of corn-fed Argentine beef will find its way abroad. It will require some strong object lessons to convince the great mass of producers, because they are doing very well at present; and until they see Argentine corn-fed steers

First-prize Clydesdale Stallion. Sold for $1,500.



First-prize Shire Stallion.

Docil, Percheron Stallion, 3½ Years Old. Sold for $2,600.

sold in England for a much higher price than the grass-fed ones they will not go to the trouble and expense of feeding. The present tendency toward mixed farming may bring it about to a certain extent, but the country is at present so divided into "zones" for this and that purpose that corn raising and steer feeding are not very likely to be done on the same estancia to any great extent for several years. The increasing demand for such animals, both in England and the United States, is an influence which will sooner or later bring about their production in Argentina, where they can undoubtedly be grown for many years very cheaply. Some feeders tried corn feeding on a small scale several years ago, with excellent success, but they had difficulty in finding any buyer in Argentina who would pay the difference. One breeder tried the sending of a few on his own account, and he says that he made a profit of over $10 gold per head after charging off all possible expense for feed and labor.

THE MANUFACTURE OF TASAJO DECLINING.

The saladeros are showing rapid falling off in their production of tasajo, or jerked beef, because they can not sell their product at a price that will warrant paying the prices for animals in competition with the frigoríficos, the beef-extract factories, the export trade, or even the city market. One great factory has been gradually made over from a jerked-meat establishment into one for the manufacture of beef extract, for which a better quality of meat is used, while only the parts undesirable for beef extract are used for tasajo. One of these companies has just paid a 20 per cent dividend.

MEAT SUPPLY OF BUENOS AIRES.

The beef supply of the city of Buenos Aires comes from one great market, where from 1,200 to 3,500 animals—steers, oxen, cows, heifers, and calves—are brought daily and sold by various commission men to the city butchers. Part of the sales are at auction, but the majority are private. The killing is all done in a place provided by the city and is under municipal inspection. Sheep and hogs, as well as cattle, are all killed here, each man killing on his own account. There is a tremendous waste, especially during the summer, as there is no refrigeration, and all meat is sold the day it is killed, or surely the next day. Many butchers buy carcasses from others who kill by wholesale and supply retailers. If the retailer, when ordering his supply the day before, overestimates the next day's business, he suffers a loss, and it often happens that the price of meat begins to fall before noon and by night is half what it was in the morning, especially if the day has been warm. The meat, besides being usually from inferior animals, is tough and stringy and full of water, shrink-

ing heavily in the cooking. It has had no time to cool, and being grass-fed is watery. Besides, it is sold by the chunk, not by weight, and is cut up in much the same manner as meat is cut for dogs or menagerie beasts. Such a thing as a sirloin or porterhouse steak is unknown in Argentina. The carcasses being hacked to pieces without regard to the choice cuts and sold at a uniform price for the whole, good and bad, makes it very difficult to get a good piece, though sometimes tender, juicy steaks and attractive roasts may be had in the best restaurants and hotels, but it is by no means a sure thing. Several efforts have been made to enforce the municipal law requiring meat to be sold by the kilo; but the butchers are opposed to it, and customers who demand the right to buy by the kilo soon learn that it does not pay, for they get more if they buy by the piece. All these conditions would seem to offer a good opening for a modern fresh-meat establishment in the city of Buenos Aires, supplying good chilled and seasoned meat, properly cut up, with more economical slaughtering and according to better methods.

The prices obtained at the Buenos Aires cattle market vary greatly, according to the quality of the animals offered and the daily demands of the market. For steers the prices run from $30 to $75, the average being probably not far from $50 to $60. For oxen, about the same. For cows, $20 to $60, with occasionally a few at higher prices—those having a little better blood that have been picked up for breeding. Heifers sell at $14 to $30 and calves for from $3 to $18, the average being somewhere around $8. Many of the cows, heifers, calves, and steers sold in this market are not slaughtered, but are bought to stock other estancias. This happens very often at the extremes of seasons or when some part of the country has suffered a drought. Under such conditions estancieros find their camps overstocked, so they keep as many animals as they dare—generally more than they should—and send the rest through this market to some more fortunate part of the country where there is feed.

Prices of meat in the Buenos Aires markets at present (May, 1903) are quoted as follows in paper money per pound and piece, but, as a matter of fact, the prices paid are less, because meat is sold by the lump cheaper than it would be by actual weight:

Beef.—Loin, 20 cents; roast, 25 to 32; boiling, for puchero, the poor man's national dish, 16; steaks, 20; rump, 16; breast, 9 to 13; ox tongues, 80 cents each; Hamburg steak, 22; bones, 9.

Veal.—13 to 36 cents.

Pork.—32 to 45 cents, and ham, imported, $2.04, domestic, 68 cents, the latter being very inferior.

Mutton.—13 to 45 cents.

Lamb.—18 to 36 cents.

Turkeys.—83 to 86 each.

Fowls.—$1.20 to $1.50 each.
Chickens.—$1 to $1.20 each.
Ducks.—$1 to $1.50 each.
Wild ducks.—40 to 70 cents each.
Geese.—$3.50 each.
Martinettas (*similar to quail but larger*).—$1 to $1.40 a pair.
Partridges.—30 cents per pair.
Pigeons.—60 cents per pair.
Rabbits.—$1.

SHORTAGE OF COWS IN ARGENTINA.

Returning to the fat-stock show: Some good, fat cows were shown, both Shorthorns and Herefords, but these are only a minor incident of the show and are usually those that have proved useless for breeding purposes. The prices obtained were very poor. The best ones, weighing from 1,400 to 1,500 pounds, were bought by one freezing company—which ordinarily kills no cows of any description—at $62 to $77, and others went for $41. The sacrifice of cows and heifers is one of the most deplorable mistakes now being made in Argentina, and is so regarded by the majority of the most progressive breeders; yet it goes on, as one may see any day by going to the "mataderos," the municipal slaughtering place in connection with the Buenos Aires cattle market. To be sure, a good proportion of these cows are of a very inferior class—"clearings," often, from estancias where the stock is being improved. But the number of cows sold for beef is due, in a large measure, to the demand for beef that can not be supplied in any other way and is another evidence that the number of cattle in the country is overestimated and has probably not increased much, if any, since the census of 1895, which placed the total number at 22,000,000. The country is short of cows, and it can not afford to kill them so long as they are useful for breeding. A proposition to restrict the killing of cows to those over 6 years old met with derision. The Government would like to do something to check this destructive practice, but as yet has not found a practical way to begin it, and the same is true in regard to calves.

These conditions indicate how strong the demand is for cows of good blood. The expositions show it by the small numbers of cows and heifers shown or sold. Those who have good cows do not like either to get them in condition to satisfy show demands or to take the risk and undergo the expense of taking them to the shows, and any good breeder who has good cows never thinks of selling them, but rather of watching for a chance to buy more. High-grade cows, as stated elsewhere, are eagerly sought for, and good prices will be paid for them, and have been paid, and are now being paid whenever they are offered.

SALES OF HORSES IN ARGENTINA.

Of the 413 horses in the May horse fair, only a few were worthy of special notice, and these were the light coach and saddle horses. The prices for the great majority of animals sold were very low, but for some of the prize animals, and for the attractive light coach and saddle horses, the prices seemed to be satisfactory, as prices go in that country. The horse business, while it has improved much, is not in as flourishing a condition as it is likely to be. Hard times, bicycles, electric street railways, and even automobiles, so it is said in the papers there, have hurt the horse business. The highest prices obtained were for coach horses, the lighter ones bringing the best prices. The first prize winner in the light coach class, a hackney Anglo-Norman sorrel mare, brought $2,100, while the third horse in the same class, a gelding from the same breeder, sold for $2,000, and the second prize winner from another breeder, $1,000. The third prize pair in coach horses, Yorkshire-American cross, sold for $1,300. A heavy Shire coach horse, second prize winner, aged 5 years, from an imported sire and purebred mare, sold for $700. The first prize Anglo-Norman saddle horse sold for $300, the second for $250, a few others at $300 to $400, and a number of attractive ones from $100 to $150. A few hackneys brought $600 and $700, but most of them went for much less—around $100 and even less—and hackney mares sold from $45 to $90. The Clydesdales brought very poor prices, and were a rather "logy" lot, most of them, though, of fairly good breeding. Perhaps the fact that grain is not often fed to horses there may have had something to do with this appearance of many horses. The first prize Clydesdales, in groups of 6 colts, sold for $150 each, the second group for $195, and the third for $225. As with the bulls in the fine-stock show, the opinions of buyers do not always agree with those of the judges who award the prizes. Other Clydesdales, pure and of mixed blood, sold as low as $35 and $36, and many went at $55 to $100, though some also commanded from $120 to $180. A great many camp-bred mares and ordinary geldings found slow buyers at $40 to $50, and even less than the lower figure. Some sold for only $15 each. These horses were not worth more than they brought, for an ordinary horse may be bought any day for $30, or less than $14 United States money. The "cocheros" (drivers of ordinary carriages for hire) in Buenos Aires, who abuse their horses shamefully, find it cheaper to buy a new horse than to feed or take decent care of the poor old animals they often are seen driving.

Some splendid mules were shown—large, strong animals that were shipped to South Africa and sold at a good price. Two lots were especially noteworthy, the result of a cross of a Poitou jack on Clydesdale mares. But an estanciero who has tried them says that

his colonists found them too slow and lazy and inferior to the smaller but more energetic mule of the country. Still the large mules are in good demand, and a few big American jacks could be disposed of to excellent advantage. Some Texas stockmen who went to Argentina a few months ago to start a stock ranch and do general farming near Lake Nahuel Huapi, in the southwestern part of the Republic, brought two big jacks, which excited a good deal of admiration, and experienced men wanted to know where more such animals could be had. The mule business was a very profitable one for Argentina during the Boer war, and the country, especially the northern part, in the province of Córdoba, has been pretty well drained of mules. The business is practically over now, but breeding is going on, and the demand for mules and for jacks is good.

SALES OF SHEEP IN ARGENTINA.

Only 240 fat sheep were exhibited in the May show, for at that time sheep breeders were rather discouraged, or had been for a year. The prices, both of wool and mutton, were very low. Plenty of sheep were sold in the early part of the year 1902 for $1 to $1.50. Fat sheep, fit for export, were bringing only $4 to $5.50, and the market for these was confined to the three freezing works. There is record of the sale of three lots of these sheep, 120 in all. Two lots of 40—one of Lincolns and one of Hampshire Downs—sold for $5.50 each, while another lot of 40 Lincolns went for $4.80.

ANIMAL SANITARY REGULATIONS.

The Argentine Government devoted much effort during the year 1902 to the task of persuading the British Board of Agriculture, not only that Argentina is free from foot-and-mouth disease, but that there is no danger of its being brought into the country from its neighbors, especially from Uruguay, and in turn sent again to the foreign cattle markets in England. Many times it seemed that the English ports, closed to Argentine cattle and sheep in April, 1900, were about to be opened, but some new objection from the British Board of Agriculture would prevent it. The influence of the English meat producers was very great and the English breeders seemed to be in great fear of another outbreak from imported infection. But at last the Argentine Government was able to comply with the conditions imposed by the British Board of Agriculture, and on February 3, 1903, the bars were let down, permitting Argentine sheep and cattle to be sent to the English ports alive under conditions similar to those required of importations from the United States. The conditions required of the Argentine Government were not severe, once the fact was established, as it undoubtedly was, that foot-and-mouth disease did not exist in Argentina and had not for a year been within

the limits of the territory from which cattle are exported or alfalfa shipped that could be infected. The best authorities in Argentina do not deny, but freely admit, that foot-and-mouth disease is liable to appear at any time in places, and it exists now in some of the distant provinces, from which cattle are not exported and but seldom brought directly to market. They are brought to better camps to be fattened before they are exported or slaughtered, and the contention is that the system of inspection within this territory is so thorough that the existence of the disease is detected immediately upon its appearance. Rigorous measures are then taken to confine it, and it is soon stamped out. So men like Ronaldo Tidblom, the chief live-stock authority of Argentina and director of the bureau of animal industry, claim that there is no danger of infected animals being exported or of arriving with the disease. No animal can be exported without having first been inspected on the estancia by a Federal Government inspector and again in the port of Buenos Aires, Rosario, or La Plata, whence animals may be exported.

The recent outbreak that caused the Argentine Government to promptly prohibit exportation of all kinds of live animals to whatever destination was confined to three estancias within 65 miles of the city of Buenos Aires. It first appeared among some imported animals undergoing quarantine in the port. The first animal showing the disease was promptly slaughtered. In a day or two 2 other animals appearing infected were also slaughtered. The next day 7 more showed the disease, and by this time the origin of it had been traced to green alfalfa brought from an estancia which was shown to have the disease. Thereupon, it being proved that the animals had not brought the disease with them from England, and that all were infected, no more were killed, and all that pass the tuberculin test at the termination of the quarantine, after they recover from the aphthous fever (or aftosa, as foot-and-mouth disease is called there), will be admitted the same as if they had not had the disease. In the meantime the places of its appearance were quarantined. The authorities do not anticipate any further spread of the disease and expect it will all be over in a month or so.[a] The closing of the ports was out of regard for the English fear of the disease and to show a determined effort to maintain a clean bill of health.

The close proximity of the Republic of Uruguay, where more or less the same conditions prevail as in Argentina, led the British Board of Agriculture to insist that the Argentine Government must either induce Uruguay to adopt the same regulations or exclude Uruguayan cattle altogether from the country. The negotiations with Uruguay were attended with difficulty. The saladeros, or jerked-meat

[a] Since this was written the Argentine Government has declared officially that the disease no longer exists in the country.

factories, on the Uruguay River, on both sides, get their cattle from both sides of the river. The stockmen of the Argentine province of Entre Rios sell many of their cattle to the Uruguayan saladeros, and the Argentine saladeros get cattle from Uruguay. There were other dealings in feeders and fat stock, so the suspension of this traffic would have entailed heavy losses. The last point discussed was the desire of Uruguay to be allowed to load live stock on the same ships with Argentine animals for England and other points. This was not agreeable to the Buenos Aires Government, as it would involve additional risk of disease appearing among the animals on the voyage and there would be no way of knowing in which country it originated. Finally the Uruguayan Government agreed to the conditions, as it shares, on equal terms, in the benefits of admission to the English market, while the work of removing the obstacles has been done by the Argentines.

The Governments of Argentina and Uruguay have made regulations in substance as follows, governing the importation and exportation of animals, in compliance with the demands of the British Board of Agriculture:

Article 1 prohibits (*a*) the importation or landing of animals, animal remains, etc., from any country where dangerous contagious or infectious animal diseases exist; (*b*) the importation of animals from a country whose laws do not, in the opinion of the executive, offer sufficient guarantee against contagion; (*c*) the importation of animals from abroad through any other port than Buenos Aires; (*d*) the importation of animals from any country that have originally come from a prohibited country; (*e*) the importation of animals in a ship which has, within thirty days of its embarkation, loaded animals in a prohibited country; (*f*) the importation of animals in a ship which, after loading, has been in contact with any kind of animals proceeding from a prohibited country, or which has called at any port of such a country; (*g*) the entry into an Argentine port of any ship which has, during the preceding sixty days, loaded animals of such a country; (*h*) the importation of animals having "garrapatas," or Texas fever ticks.

Article 2 prohibits the exportation of animals attacked by contagious diseases, or suspected of being so, or bruised, and of those that have not undergone veterinary inspection on the estancia and at the port of embarkation, and that have not been transported in disinfected vehicles. Also exportation in a ship which has on board animals from a prohibited nation or that has not been disinfected after having remained in or touched at, during the preceding sixty days, the port of a nation under prohibition by reason of the cattle plague, or during thirty days, if prohibited on account of the existence of pleuro-pneumonia, foot-and-mouth disease, or glanders; also the exportation of cattle having the Texas fever ticks.

The importation of all classes of animals from Russia, Roumania,

Servia, Cape Colony, Natal, Orange River Colony, and other British colonies in South Africa; the German and Portuguese possessions of East and West Africa, the French possessions of West Africa, and Madagascar, Bolivia, Ecuador, Peru, Venezuela, Colombia, and English, Dutch, and French Guiana is prohibited.

Importation of cattle, sheep, goats, and hogs from the continent of Europe, Australia, Brazil, Chile, Paraguay, and from the States of Maine, New Hampshire, Vermont, Massachusetts, Connecticut, and Rhode Island, of the United States, is prohibited. There is no prohibition against the rest of the United States, the New England States having been included in the prohibited list because of the outbreak of foot-and-mouth disease there. This prohibition will be removed when the disease, in the opinion of the United States Department of Agriculture, is effectually stamped out.[a]

Article 4 requires that animals imported must be accompanied by a certificate (in the United States from the Department of Agriculture) showing that the cattle plague has not existed for ten years in the country from which they proceed; and that neither pleuro-pneumonia nor foot-and-mouth disease has existed there during the preceding six months; that as regards sheep it must be shown that no case of small-pox in sheep has occurred during the six months; as regards horses a similar certificate in reference to glanders and lampas. This certificate must be indorsed by the Argentine consul at the port of embarkation.

Provision is made for the inspection of ships bringing live stock and for segregation and quarantine, or destruction if they have the prescribed diseases, of animals not found in perfect sanitary condition.

Article 6 specifies the quarantine and inspection of animals imported, as follows: Cattle, 40 days, during which neither the owner nor anyone representing him may have access to the animals. At the expiration of this period cattle are subjected to the tuberculin test, and if they react, showing that they have tuberculosis, they must be slaughtered without compensation or removed from the country within 8 days. Sheep are to be kept in quarantine and isolated for 15 days and horses for 8 days. Horses may be tested for glanders at the expiration of the quarantine period, and if they have the disease, or if they have been in contact with horses suffering from glanders, must be slaughtered without compensation. The length of the quarantine is at the discretion of the director of the division de ganaderia (bureau of animal industry) and may be extended, though it is not likely to be.

Special provisions are made for commerce between the Republics of Argentina and Uruguay, requiring thorough inspection and dipping in the official dipping places for killing ticks. Importations from

[a] Foot-and-mouth disease has entirely disappeared from the United States, and on July 20, 1903, the Secretary of Agriculture issued an order reopening the port of Boston for export cattle.—EDITOR.

Uruguay are not subject to the same regulations as other countries, the certificate of health of cattle and other animals being more inclusive and being given from each section of the country from which animals proceed.

CONDITIONS AND COST OF ADMISSION OF BREEDING STOCK.

All breeding stock is admitted free of duty. Importers should form a connection at Buenos Aires before shipping, as it will be a great advantage upon arrival.

The auction house of Adolfo Bullrich & Co., of Buenos Aires is one of the most prominent in Argentina; in fact, it sells more than half of all the breeding stock sold in the country. The founder of the establishment has been mayor of Buenos Aires two terms, and he will spend some months this year traveling in the United States studying our breeding establishments. His son, Eduardo Bullrich, is the manager. These men speak English and have a wide knowledge of the country and large acquaintance and influence with breeders of Argentina.

Breeding stock, feeding stock, farms of all kinds, city property, and almost everything, in fact, is sold at auction in Argentina. The sales are held in a great market, running through from one street to another, in the very midst of the business district. Here the animals are kept on exhibition for two or three weeks generally previous to the sales. The sales are well advertised and are attended by the leading breeders, especially during the spring sales—in September and October.

The service in the embarcadero, where animals are detained during quarantine and the owners are not allowed to see them, is generally quite satisfactory to the English importers of Buenos Aires. There has been no complaint aside from one lot, but, on the contrary, the service has been complimented. There is no cause to anticipate any trouble or excessive charge, the regular rates being given herewith. The auctioneer's commission is 6 per cent on sales, and the other expenses upon arrival in Buenos Aires, aside from personal expenses, until the animals are sold, are as follows:

At the landing stage, or embarcadero:	
Unloading cattle or horses, per head	[a]$2.00
Unloading sheep, per head	.50
Feed (hay, maize, and bran) per diem per head—	
Cattle and horses	1.50
Cattle and horses, with oil cake and oats	2.00
Sheep (hay, maize, and bran), per head	.40
Entrance and crane fee (Government tax on landing stage)—	
Cattle and horses, gold	.05
Sheep, gold	.01

[a] All reference to money, unless gold is specified, is in Argentine paper, worth 44 cents in United States money on the dollar.

Clearing at the custom-house:
Stamps for clearing, $1 per $1,000 declared value.
Stamps for documents, $6.75 on each consignment.
Fee of custom-house broker, from $10 to $25, according to shipment.
At the auction house:
Feed (hay, maize, bran, and oil cake) per diem—
Cattle and horses, per head $2.00
Sheep, per head ..... .50
Driving from landing stage pens to auction mart:
Cattle and horses, per head 1.50
Cartage of cattle, according to number of animals, as may be arranged.
Cartage of sheep per cart 2.00
Receiving animals and delivery at auction mart is gratis.

So little business has been offered in recent years that there are no regular fixed rates on the shipment of animals from New York to Buenos Aires. Four English companies run regular steamers direct from New York to Buenos Aires, and they have all expressed a willingness to accommodate shippers of pedigreed stock to a greater or less extent. These companies are the Prince Line, the Lamport & Holt Line, the Norton Line, and Houlder Brothers. The rates are as follows, in United States money: Cattle, $55 per head; sheep, $13.20 per head; horses, $82.50 per head; donkeys, $27.50 per head.

The animals will usually be carried on the after deck, in the open, with proper cover. The voyage, except the last four days, is a smooth and warm one usually, especially in the season when shipments should be made. From Rio de Janeiro to Montevideo it is likely to be cool and rough in July and August, so that precautions should be taken to protect the animals.

The steamship company supplies nothing but water to the animals. All feed must be supplied by the shipper, but it is carried free unless there is a large amount in excess of what is required; in that case it is charged freight at the rate of $3.86 per ton. Where 6 cattle, or 25 sheep, or 4 horses are shipped at one time, free passage is given to one attendant unless he requires cabin accommodations, in which case he is charged $50 passage money. The voyage is not an unpleasant one; the ships are fairly comfortable for a few passengers, and it is highly advisable that valuable animals should be in the care of some one who understands them and is personally interested in their welfare. Arrangements can be made with the captain of the ship for the care of the animals by the crew, however, for a small fee. It is of the utmost importance that the animals shall have plenty of cool, fresh water during the voyage, not only for drinking, but for bathing the animals while passing through the Tropics. Salt water will not do, as it causes irritation of the skin and makes the coat look rough. Coal dust has the same effect. Stalls should be padded for the same reason, as it will pay to make sure that animals arrive looking as well as pos-

sible. A laxative should be provided for use while passing through the Tropics. The length of the voyage varies from twenty-three to thirty days.

Insurance on the animals against all risks may be had in reliable companies for from 5 to 10 per cent, depending upon the line and the ship, and it is advisable to carry insurance, as the steamship company does not assume any responsibility.

THE DAIRY INDUSTRY.

During the year 1902 Argentina exported 9,308,200 pounds of butter, chiefly to England and South Africa. This was an increase of 187 per cent over the exportation of the previous year, which was 3,232,391 pounds. There are no statistics of production for home consumption, but the best estimate available—that of the Rural Society—puts the production of the province of Buenos Aires at 20 tons per day. The production and consumption of butter outside this province is not possible to estimate closely, but certainly all the rest of the country does not produce 10 per cent of the amount produced in this province, if we leave out of the account the amount produced and consumed in the city and vicinity of Rosario, the second city of the Republic, having a population of over 120,000. Even this city is supplied, to a large extent, from the province of Buenos Aires, for as yet only a small proportion of the estancieros are making butter. The private production and consumption must also be omitted in this comparison, for that is increasing on the estancias. Still there are thousands of people owning various numbers of cattle who either go without butter or buy it in the towns.

The city of Buenos Aires, with its 876,000 people, is, of course, the chief local market for Argentine butter, and it is well supplied with a very good quality. The consumption is estimated at only 4½ pounds per capita per annum. The working classes do not have butter on their tables as they do in the United States. The present price in the city is about 22 to 24 cents gold per pound.

To supply the demand there are four great factories or systems of factories. Their plan of operation is something unique. The industry is, of course, only in its incipiency, but it is interesting to note the process and rapidity of its development, its extensive possibilities, and the probability of its immediate and tremendous growth.

La Union Argentina, the chief butter maker of Argentina, is a cooperative creamery on a very large scale. It was organized in 1899 to save the butter industry from the collapse that threatened it, which was due to the wastefulness of small individual production and the lack of uniformity and modern methods. The last report of the

Argentine Rural Society gives an account of the organization and operation of La Union Argentina, which is in substance as follows:

The applicant for membership must be a producer of milk, agree not to dispose of it or any of its products except through the society, and he must own five shares. But one need not be a member in order to receive the benefits of the organization, since members and nonmembers are treated alike in the charges for services rendered, and are paid the proceeds of sales in the same manner and at the same time. The society receives any amount of milk or cream from any person, whether member or not, to be made into butter. Patrons of the society pay the expenses of the creamery—freights and other expenses—in proportion to the value of their consignments. Those who send milk are not charged for the use of the separators. A commission of 8 cents paper per kilo is charged on the butter made from either milk sent in and separated or from cream that has been separated before being sent to the factory. This amounts to about 1.6 cents gold per pound, and is to cover the following charges:

(1) Freight charges on milk or cream.
(2) Cartage on cream from the railway station in Buenos Aires to the factory.
(3) Attending to orders for utensils, for fuel, instructions, etc.
(4) Cans for transporting cream.
(5) Inspection of the separators by frequent tests of the separated milk.
(6) Making, care, and sale of butter.

The society does not purchase milk or cream, nor does it guarantee any fixed price for the butter made from either. After testing each consignment it is made into butter, and the directors fix the basis for making up the monthly accounts in accordance with the prices obtained.

The society had thirty-five producing members on the 1st of May, 1899, and the increase has been so rapid that in September, 1902, it had 1,134 consignors of milk and cream, members and nonmembers, and forty-three creameries throughout the province of Buenos Aires and two in Entre Rios. Since the latter date four new creameries have been started in the province of Entre Rios. These new creameries were started by the producers subscribing for the stock to the extent of the cost of the machinery, at the same time declaring in writing how much milk each can furnish daily. Each of these creameries is separating about 7,000 quarts of milk per day. The society has many cream-separating stations throughout the country, wherever the milk can be obtained in sufficient quantities. The daily production of the society is now about eighteen tons.

A creamery in Argentina means a place where cream is separated from milk and the cream sent to the factory in the city to be made into butter, cheese, or other milk product. What we understand as a creamery is called a "fabrica de manteca," or butter factory, in Argentina. La Union Argentina makes all its butter in Buenos Aires, receiving cream from many stations, or creameries, scattered all through the provinces where dairying has been taken up. Two of these stations are in the northern part of the Province of Santa Fé, in the Jewish colony. The cream is sent daily to Buenos Aires, twenty hours by train, in all weather, without ice. The colonists get about 2½ cents paper per liter in winter and 3½ cents in summer for their milk, equivalent to a trifle more than 1 cent gold per quart in the winter and 1.4 cents in the summer, with which they are well satisfied. They set the cans containing milk out in the road in the hot sun and the creamery wagon comes along and picks them up, dropping the empty

cans in the same manner. The skimmed milk is used at the creamery to feed pigs.

The railway rates for the transportation of milk and cream, per 100 kilos (220 pounds) are as follows, in Argentine paper money:

Less than 50 kilometers (31 miles): Southern, $1.36; Western, $1; Rosario, $0.90; and the Pacific, $0.73.

From 50 to 100 kilometers (31 to 62 miles): Southern, $1.57; Western, $1.20; Rosario, $1.70; and the Pacific, $2.40.

From 200 to 300 kilometers (124 to 186 miles): Southern, $2.18; Western, $2.86; Rosario, $3.40; and the Pacific, $6.

From 300 to 900 kilometers (186 to 559 miles): Southern, $2.27; Western, $3.64; Rosario, $4.30; and the Pacific, $9.

The Jewish colony referred to ships by the Rosario line and pays the highest figure, as it is 355 miles from Buenos Aires. There is much complaint, especially from dairymen near Buenos Aires, of the high rates of transportation maintained by the railways.

The society protects the reputation of its butter product by requiring every exporter to brand the cases "Producto Argentino," and to receive shipments on shipboard directly from the society. The price obtained by the producer is not far from 80 cents paper per kilo, or 16 cents gold per pound. The average price in London in 1902 was about 22.5 cents gold per pound, leaving a comfortable margin to cover the cost of shipment and give the exporter a satisfactory profit. The average Buenos Aires prices, in December, for four years, have been, in gold, as follows: 1899, 19.2 cents; 1900, 19.6 cents; 1901, 20 cents; 1902, 18.2 cents.

Argentine butter has won a good reputation in the English markets, and has been sold in competition with the French, Holland, and Australian products at prices almost as good as the best, and it has been gaining in price as well as in quantity exported. The amount of the exportation is increasing rapidly, as new creameries are being erected, and the capacity of those already in operation is being enlarged. New territory is being opened up and separating stations established, where the milk is brought and the cream taken out and sent to Buenos Aires or some other place to be made into butter.

Argentine butter is of a very good quality, and uniformity is secured by the large production under one management. It lacks the firmness and grain of United States butter, however, and even without considering the fact that it is never salted, unless so ordered, it does not seem to have quite the rich flavor of that made in the best creameries in the United States. However, it suits the European market very well and is gaining ground there. The South African market is also an important one for Argentina in this respect, as in others. The salted butter, which is worked twice, being left to stand

over night after salting, is of a very fine, even quality, firm and rich in flavor, and compares very well with that made in the United States.

The city of Buenos Aires has three great dairy companies that supply all milk products to the people at retail and also make some butter for export and for sale outside Buenos Aires. There are two or three other butter manufacturing companies that buy milk and cream and export butter, and within a year or two these will be numerous.

The dairy business in the city of Buenos Aires is interesting and in some ways unique. Three companies have large dairies of their own, where attention has been for some years given to the breeding of milch cows. The peculiarity of the dairy industry there is the establishment all over the city by these three companies of little lecherias, or milk depots, where milk is sold in every form, both fresh and manufactured. These little shops are located in all parts of the city, even on the principal shopping streets, and are very clean and attractive. The interior is always painted white, and the attendants are usually young women. Milk as a beverage is popular, and all these places have it fresh, sweet, and cool, and also buttermilk and other milk beverages. A large glass of milk costs 10 cents paper, or a little over 4 cents of our money. It is estimated that the three companies sell daily from 18,000 to 19,000 glasses. The daily consumption of milk in the city is about 200,000 liters, or 211,340 quarts. These hygienically conducted establishments sell about one-fifth of it The rest is sold in a multitude of ways by small dairies. Many of them drive the cows about and milk them in the streets as the milk is called for by their patrons. Others do not take the cows out, but keep them in prominent places in the city, and milk them on order, so people can see what they are getting. Some lecheros (milk sellers) still go about in the old fashion, with milk cans on horseback, as they still do in the provincial towns. The three companies referred to sell milk at 15 cents per liter, or 20 cents delivered. The prices obtained by the other milk sellers range from 8 to 20 cents paper per liter, according to the quality of the milk and the repute of the dealer. The city has a system of inspection of milk, but through lack of sufficient inspectors it is not very efficient. The milk is usually of a fair quality, and that of the three companies is always good. Sterilized milk, which they prepare and sell in sealed bottles, is much used.

Two of the three companies have contributed to the advancement of the dairy industry by the development of manufactured products from it. One has two fine estancias about 60 miles from Buenos Aires stocked with about 2,000 cows, as well as other stock. The cream is separated from the milk on the estancia, and only the cream is sent to the factory in Buenos Aires. Casein, also an important export product, is taken out of the milk after the cream has been extracted, and

what remains is fed to pigs. Besides butter and sterilized milk, the dairy companies make a preparation peculiar to Argentina, known as "dulce de leche," literally, "sweet of milk." This confection is made by boiling whole milk and sugar for several hours, with constant stirring, until it becomes very thick, a sugary paste that is delicious as a dressing or as a dessert by itself, and is very popular there. The people make it themselves and use it freely. Condensed milk of excellent quality, both sweetened and natural, is made by these companies. Another milk product that has found high favor in Buenos Aires is that known as "leche maternizada," or baby's milk. One company has been especially successful with this milk prepared for infants. It is put up in sealed bottles, and it retains its sweetness without carrying any deleterious substance. People taking long voyages often take hundreds of bottles of this milk for the use of the baby. The same company makes fine toilet soap and several other products from milk. Two put up butter in small tins, also sterilized milk, for export.

The keen rivalry among these companies, especially the two best known, shows the interest taken in the development of the dairy industry. Their exhibits at the recent show attracted more attention than any other feature. The business in all these lines is developing with a rush, but it is certainly permanently established and destined to be one of the chief sources of Argentine wealth. The waste of milk that has been going on in the country has begun to decrease; estancieros are beginning to understand the importance of making the most out of the milk and to see the mistake they have been making in allowing the calves to have it.

SELECTION OF COWS FOR MILKING QUALITIES.

Estancieros are looking to their breeding to get milking qualities, something to which the average breeder has given no thought heretofore. The dairy breeds, except the Jersey, are attracting more attention. For this reason milk-giving Shorthorns will commend themselves to Argentines, provided that they are also meat producers; that is, a Bates cow or bull, known to have a good milk-producing inheritance, will be regarded very favorably, provided the animal promises to produce first-class beef animals also. Formerly nothing but beef was thought of; cows were rarely milked, and calves ran with their mothers until they were 8 or 9 months old. Now they speak of taming cows to milk as they would of breaking a wild horse. The progressive breeders and estancieros are making selections of their cows with regard to their milking qualities, and are seeking to improve the amount and quality of the milk of their offspring.

Holsteins have some strong admirers, and Dr. Enrique Fynn, one of the principal breeders of Argentina, is about to make a visit to the

United States to secure some new breeding stock which the laws of Argentina do not permit him to bring from the Continent of Europe. He is well satisfied as to the superiority of the Holstein for his purpose and as a meat producer at the same time. The Holsteins are stronger in the country than any other of the special dairy breeds.

Flemish cattle have been bred for fifteen years on one estancia near Las Heras, about 60 miles southwest of Buenos Aires. One owner has won many prizes with his cattle. He obtained his first stock nearly twenty years ago and has imported a number of well-bred cows from Belgium since. The importation of cattle and sheep from the Continent of Europe to Argentina is prohibited under the agreement with England whereby the English ports were reopened to live animals from Argentina, but such importation had not been permitted for two or three years before. There is no likelihood that European animals will be admitted to Argentina for many years. The supply of Flemish and Holstein breeding stock is very small in the country. There are but two or three herds of each worth mentioning and scarcely any first-class breeding stock is on the market. The strong interest in the dairy industry makes it certain that superior purebred animals of this class which, in addition to their well-known milk-producing powers, show beef qualities at the same time, will find a quick and very satisfactory sale in this market. This applies to Shorthorns as well as to Holstein and Flemish cattle. Tiptop young animals may be relied upon if properly presented to bring anywhere from $800 to $5,000 gold, and $1,500 would seem to be a safe figure to count on. If the animals were of right kind in all particulars they would bring more rather than less if offered at the right time.

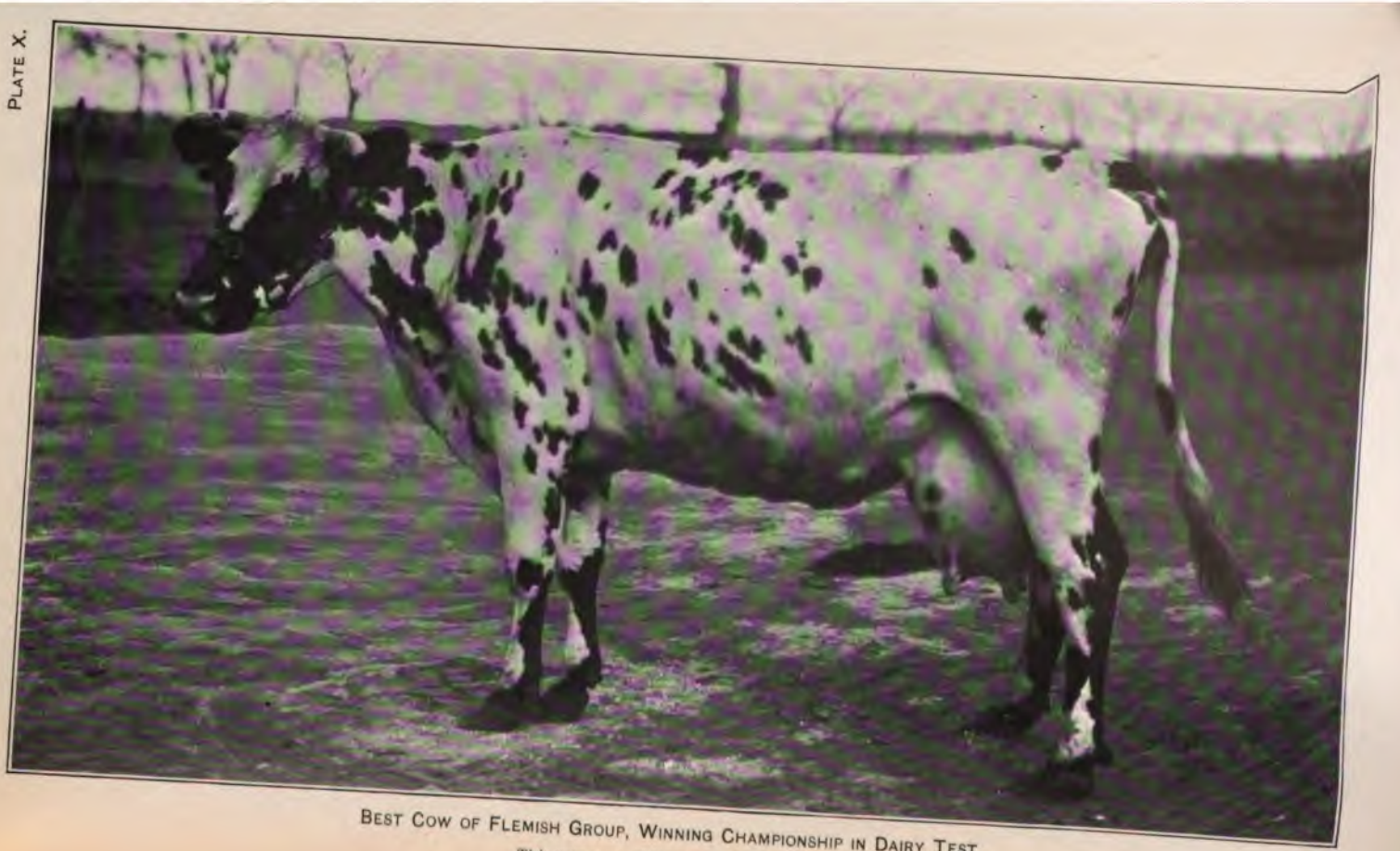
One breeder has been trying a cross between Shorthorn and Flemish cattle with significant results. Shorthorn and Shorthorn-Flemish steers of the same age were prepared for market under precisely the same conditions. The Shorthorns averaged 1,218 pounds, while the cross-bred steers gave an average of 1,441 pounds. It is claimed for this cross that it produces a cow almost as good as the Flemish and a steer better than the Flemish and generally as good as the Shorthorn; that the cross-bred steer is hardier than the Shorthorn and matures equally early. The milk test in the recent show also gives some strong evidence favorable to this cross, which now has many advocates and is likely to be tried by others.

But those who believe in producing milch cows by a careful selection of Shorthorns are probably four times as numerous as the supporters of all other breeds combined in Argentina, for no claims are made for the Hereford in this respect

TEST OF DAIRY COWS.

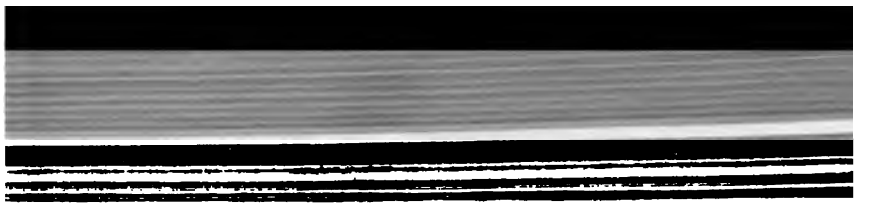
The practical test of dairy cows was one of the most interesting and instructive features of the exposition. The competition was among

DE WET, FIRST-PRIZE HOLSTEIN BULL, 22 MONTHS OLD. SOLD FOR $1,050.



BEST COW OF FLEMISH GROUP, WINNING CHAMPIONSHIP IN DAIRY TEST.

This cow gave 35 liters of milk per day.



lots of 5 cows each. They were given the same food and milk morning and evening for three days under the inspection of the judges. Seven lots of Shorthorns, two of Holsteins, one of Shorthorn-Flemish, and one of Polled Angus were entered. Championship prizes were offered for the group showing the greatest aggregate quantity of milk, quality considered, and for the one showing the greatest percentage of butter fat. All the cows were accompanied by their calves and had, of course, been carefully selected and prepared for this competition, though they had not been allowed to become fat. The result was very gratifying to the advocates of the Flemish and the Shorthorn-Flemish cross. The fact should not be overlooked, however, that the Flemish cows were the result of fifteen or twenty years of careful and intelligent selection from a large herd of the best original Belgian stock and its descendants, while the Holsteins have had only six years of selection from a comparatively small herd.

The Holstein people here feel sure that their breed will furnish a better animal for beef and milk combined, alleging that—

(1) Holsteins are hardier, better adapted to the open life of the Argentine camp, to which they are subjected, than either Shorthorns or Flemish. Holsteins, they say, do better in the open camp than under shelter, requiring the freedom of the open air to produce the best results.

(2) Holsteins are less liable to disease than either Flemish or Shorthorns.

(3) The milking qualities of Holsteins of the same care in breeding and selection are equal to Flemish, and they generally produce better beef animals.

The official report of the milk tests, on which the awards of both championship prizes were made, and others, is as follows, as reduced to our weights and measures:

Record of tests of dairy breeds of cows.

The produce of 5 cows in each lot for three consecutive days.

Breed.	Milk.	Butter fat.	Butter.
	Quarts.	*Per cent.*	*Pounds.*
Flemish	357.12	3.175	25.58
Shorthorn-Flemish	300.63	3.883	26.61
Holsteins	359.86	3.033	22.49
Do	255.72	3.075	17.59
Shorthorns	236.70	3.701	19.86
Do	184.65	3.658	18.47
Do	278.96	3.983	18.47
Do	226.39	3.325	16.91
Do	194.15	3.816	16.71
Do	165.37	3.316	12.26
Do	149.51	3.083	10.36
Polled Angus	210.80	3.400	16.18

SACRIFICE OF COWS.

There is no reliable or complete information as to the number of cows being milked or the number not being milked. No live-stock census has been attempted since 1895, and the best-informed men in the country do not believe there has been much increase in the number of animals since that time, if there has been any increase. So many losses have been incurred, so many cows have been killed, and the younger animals have been drawn upon so heavily for export that the natural increase has been kept down. One estimate, crediting each cow with 30 kilos, or 66.13 pounds, is that only 137,000 cows supplied the export butter trade of 1902. Against this development of a small percentage of the cows of the country, to which should be added those employed in producing butter for home consumption and other milk products, which, all told, can not be more than 1,000,000 and probably fewer, we have some idea of the destruction of cows. In 1902, 96,900 cows were slaughtered in the saladeros, or jerked-beef factories. This was more than three times as many as were consumed there in 1897, when the number was 32,093. In the Buenos Aires slaughter yards 84,902 cows were killed for beef in 1901, and in 1902 the number was 109,890. The same thing is going on all over the country. To be sure, the cows slaughtered are the inferior ones, but by no means old ones only. It suits the men who are improving their stock to get rid of the poorer cows to the best advantage, and that is for slaughter.

"But it is a bad thing for the country to have so many cows killed," says Ronaldo Tidblom, director of the bureau of animal industry. "The better class of estancieros, those having valuable camps, may not find it to their advantage to keep these cows, but they are needed outside on lands not so valuable, where any cow is better than no cow. For the interests of the country at large, we can not afford to have so many young cows slaughtered, and measures will be taken to prevent the killing of cows under 5 or 6 years old. We would like to say 7 years, but that is impracticable, because it is difficult to keep account of the age of cows after they have all their teeth. So the best we can do is to prohibit the killing of cows before they have all their teeth and are known to be 5 or 6 years old. Then we hope the surplus cows of the inside camps will find their way outside, where they are needed. This subject will be discussed in congress this winter and something will be done."

STATISTICS OF PRODUCTION AND CAPACITY.

The dairy industry is not yet sufficiently organized to permit one to say what it costs to produce a pound of butter, or what the average yield of milk per cow is, or what cows are worth. These things

can only be approximated. It is safe to say that the average estancia cow does not average much more than 5 or perhaps 5½ quarts per day, and that this milk will not test on the average through the year more than 2.8 to 3 per cent butter fat; in many cases it will be more, and in the fall—in April and May—the percentage of butter fat will rise considerably. Some herds will average 3 per cent or a trifle more, but 3 per cent the year around is considered good. As to yield in quantity, many cows will not give more than 4 or 4½ quarts per day, while others will give much more. The following estimate is given by the Rural Society in its annual report, the information having been furnished by La Union Argentina:

To produce a pound of butter, 10 English quarts (equal to 12 United States quarts) or about 25 pounds of milk are required. The cows in our dairies and estancias, a cross of Shorthorn and criolla (the native half-wild stock) will yield about 5½ quarts per day, remaining in milk for about 210 days. It must be remembered that in all dairy herds there are always about 30 per cent of the cows that can not be milked for one reason or another.

The average cost of a dairy cow and calf is about $30 (United States); if the yield is greater than the average of 5½ quarts, the cost is proportionately higher, as it is considered that each additional quart of milk yield represents an additional value of about $5 gold; so a cow giving 9 quarts is worth from $45 to $50, and if it gives from 13 to 15 quarts, $65 to $75. About 90 per cent of our dairy cows are graded Shorthorns. Three cows with their calves require about two squares (8½ acres) of land. Rent of land is about $1.50 gold per acre per year. Care and milking in each dairy (120 to 150 cows) requires three experienced men. The wages of these men would be a little over $15 gold per month, with board and lodging, which represents about $8 gold in addition. The price paid for milk by the creameries is about 1½ cents gold per quart.

The prices here given for cows are rarely realized except for the very best class of graded Shorthorns—known to have good blood. The average cow sells for half or less than half the amount quoted. The rental price for land is low except for land far out in the outside camps.

At present the business is confined to the northern two-thirds of the province of Buenos Aires, southern and eastern Córdoba, and most of Santa Fé and Entre Rios, except the northern parts, where it is too hot. The development of dairying is not only increasing with great rapidity in that territory, but is going beyond it, especially to the south and west, so it seems safe to count on seeing several million more cows being milked in two or three years and a consequent enormous increase in the exportation of butter from Argentina.

In the dry times and in the spring when the grass is watery the tests for butter fat run very low. One of the oldest and best herds of beef Shorthorns has had cows giving at these times as low as 1.7 to 1.8 per cent. Reliable creamery tests through the year gave this herd but 2.31 per cent butter fat on about 300 cows—a very low average. In the same vicinity another herd, consisting of Shorthorns, grade Short-

horns, and a slight strain of Jersey in some animals, averaged 3.22 per cent of butter fat, which is above the general average for that section of the country. A herd of Jerseys belonging to the creamery, of which 250 are always being milked, gives 4.36 per cent of butter fat. All these tests cover a period of twenty-two months, four composite tests being made each month. The locality was Carcarañá, province of Santa Fé, near Rosario, and the period included a very serious drought, during which the cows suffered much. Some of them were fed a little dry alfalfa during the worst time. The creamery herd of Jerseys is fed nothing but a handful of chopped alfalfa and bran at milking time to keep them quiet. During this period of twenty-two months the Jerseys on alfalfa averaged 6½ liters daily, though this is far from a fair indication of what they do there, because of the drought and short pasturage. Many individuals in this herd give 20 liters a day when in full flow and test 6 per cent butter fat—sometimes as high as 6.8 per cent. The Jersey calves are taken from their mothers as soon as they are born, and most of the bulls are sold as soon as possible for veal. Though they are very well bred, and in the United States would be valuable for breeding animals, there is no demand for them there. The Jersey is a very unpopular breed in Argentina because it gives so little beef, and, though occasionally a rich estanciero or breeder has a few Jerseys for his own family use, they are regarded as an expensive luxury. The Carcarañá people raised a few steers from their Jerseys for their own use and found the beef good, though the animals were small.

CHEESE BUSINESS NOT SATISFACTORY.

The Carcarañá creamery is managed by an American and is one of the oldest in the country, having until recently a very profitable, almost monopolistic, business in cheese. The Carcarañá cheese is famous all over the country. The factory was started many years ago by a citizen of the United States, who died about two years ago. At first it was a butter factory, but the cheese business, once the conditions peculiar to the country were mastered, was very profitable until others began to follow them into the industry, which resulted in overstocking the limited Argentine market with various sorts of cheese. The overproduction reduced the price one-third; now it is only about 80 cents paper per kilo, or about 16 cents gold per pound. They tried to export, but lost money in the South African market.

The Carcarcañá cheese is a rich full-cream cheese of excellent quality, but, like all other cheese made in Argentina, its sale is and will for some time be limited. The cheese industry in the country is more or less in this condition generally and is not very prosperous; therefore attention is turned chiefly to butter.

EXPERIMENTS IN COMPARISON OF BREEDS.

An experiment recently made on the Grañja Blanca estancia, near Las Heras, 60 miles southwest of Buenos Aires, gives a reliable record and comparison of four lots of cows—two of Shorthorns, one of Flemish, and one of Holsteins—covering an entire year. The following table gives the result in United States quarts:

Milk yield and percentage of butter fat in cows of different breeds.

Year and month.	Herd No. 1, 170 Shorthorns.		Herd No. 2, 170 Flemish.		Herd No. 3, 130 Holsteins.		Herd No. 4, 170 Shorthorns.	
	Quarts.	Percentage of butter fat.	Quarts.	Percentage of butter fat.	Quarts.	Percentage of butter fat.	Quarts.	Percentage of butter fat.
1901.								
July	18,927	3.7	17,964	3.2	10,908	3.0	17,355	3.1
August	22,173	3.7	13,758	3.3	17,769	3.4	19,368	3.3
September	20,302	3.4	19,243	2.6	14,122	3.4	17,966	3.0
October	22,847	2.9	22,736	2.6	17,030	2.6	20,483	2.9
November	30,411	3.1	30,594	2.4	15,202	2.7	32,536	2.8
December	33,955	2.8	31,669	2.6	21,633	2.7	42,479	2.8
1902.								
January	34,574	3.4	31,173	2.9	24,917	3.1	48,376	3.1
February	34,942	3.5	30,181	2.7	22,620	3.0	42,226	3.1
March	28,916	3.8	30,560	3.2	20,365	3.3	33,815	3.4
April	26,897	4.3	30,266	3.2	13,743	3.6	27,063	3.6
May	19,047	4.3	27,419	3.3	13,093	3.6	17,689	3.7
June	17,662	3.8	25,382	3.1	12,336	3.5	13,959	3.1
Total	310,153	.....	310,945	.....	203,738	.....	333,315	.....
Average	.....	3.6	.....	2.9	.....	3.2	.....	3.2

Condensed statement.

Breed.	Total production.		Production per cow.		Average of butter fat.
	Per year.	Per day.	Per year.	Per day.	
	Quarts.	*Quarts.*	*Quarts.*	*Quarts.*	*Per cent.*
No. 1, 170 Shorthorns	310,152	850	1,824	5	3.5
No. 2, 170 Flemish	310,945	852	1,828	5	2.9
No. 3, 130 Holsteins	203,737	558	1,567	4	3.2
No. 4, 170 Shorthorns	333,316	913	1,960	5	3.2

The Shorthorns have been going through a process of selection for eleven years, especially herd No. 1, showing a little better results than herd No. 4. The Flemish cows were bought only two years before and were not selected animals; many were only heifers, so the comparison is hardly fair to them. The Holsteins have been on the place six years and included practically the entire herd of this breed, both inferior and superior. The Gerber test was used to determine the percentage of butter fat in the milk. These averages are considered very good, running through the year, of cows kept all the time in the

open camp. Another test near Buenos Aires, of which careful record was kept every day for ten years, for each individual cow in a herd of 200 grade Shorthorns, nearly pure, shows a steady average of 3 to 3.5 per cent of butter fat through the year. These cows were in the open camp, on natural grasses, with perhaps a little dry alfalfa in the winter.

HOW COWS ARE FED.

The cows in the Grañja Blanca experiment were given no dry feed, except occasionally a little dry alfalfa, when the pasture was dry in the winter; but this is done only by a small minority of estancieros. Most cattle—and, indeed, these cows most of the time—live and fatten and the cows give rich milk the year around on the native grasses and nothing more. They do not have so much alfalfa in this part of the country as in others, as it does not do well. Alfalfa in this section lasts only seven years at best, and if cattle are put on it, only two years, as a rule. But the native grasses are very rich and, in ordinary times, furnish abundant feed through the year. There are winter grasses and summer grasses, succeeding each other, so that there is always fresh grass; and, unless a drought occurs, there is never need of giving dry feed, even to fatten steers. The estimate put upon the carrying capacity of the native grasses in this district is 2 cattle per square (4.17 acres) the year around, or 1 per square for fattening. In the spring and summer the camps will carry more, especially the so-called refined camps, that have been in use for some years with cattle and not overstocked, so the better grasses predominate. But if pastures are stocked to the limit in the summer they will not be in condition to carry the cattle in the winter.

Not only the wild native grasses, but several of the tame grasses and forage plants well known in Europe, which it is declared have never been artificially planted here, are to be found in these refined[a] camps. Among them are white clover, rye grass, and timothy, all of which I have seen growing on Buenos Aires estancias, where people insist that it has never been planted. There are several others of these grasses that appear and flourish at different times in the year.

The thistles of Argentina were once considered one of the most valuable cattle foods, and in all the camps that are without alfalfa they are yet highly valued, and often come in very opportunely when other pastos, or grasses, are not at their best, especially in winter. In fact, it was with serious hesitation that estancieros began to destroy the thistles in order to put in alfalfa. The pioneers in alfalfa began more than twenty years ago, and among the earliest and most prominent of them were the Benitz Brothers, from California, on their estancia "La California," about 70 miles northwest from Rosario, the second city and produce market of Argentina. They were the first to have a league of land in alfalfa. When they began they were warned

[a] A refined camp is a portion of the country better developed than others.

by the natives of the folly of plowing up the thistles, and were assured that they would suffer for it, but their success has proved that they were right.

But the usefulness of the thistle is not entirely past. The three principal varieties that mark the "refinement" of the camp are cardo negro, or black thistle, the first to appear: cardo de castilla, or Spanish thistle, which follows in two or three years; and cardo asnal, or coarse thistle, the last to appear, after the camp has been in process of "refinement" for several years. The last is the best for cattle and is considered a valuable forage plant in some sections where there is no alfalfa. It is green in the winter, even in dry times, and the cattle like it.

CARRYING CAPACITY OF PASTURES.

The carrying capacity of an Argentine camp varies so widely from the rich alfalfares, or alfalfa pastures, and inside natural camps to the more or less barren outside camps that it is impossible to say what the country at large will do. Director Tidblom makes an estimate of 1 bovine animal to 6 acres and 1 sheep to 1 acre. This applies to the distant pampas, where the grasses are not so rich and the water is scarce, but it does not apply to the sections in which cattle are fattened, or where they will be fattened for a good many years. Regions like that will produce stock cattle to be fattened on richer pasturage, nearer market. In the province of Córdoba, for instance, the natural grass, or pasto fuerte, as it is called, will carry about 800 animals per league, or 1 to 8 acres, but they do not get fat by any means. On the same land put into alfalfa 3,000 head of cattle are kept fat the year around. The land is divided into several poteros, or pastures, and the cattle are moved about from one to another of these. There are plenty of places in the country where the same conditions prevail, and they are fast being made over into alfalfares. Many landowners are gradually working their land into alfalfa by colonizing it and thus earning enough from wheat or flax in the first two or three years to pay all the expense of putting it into alfalfa, which the owners could not afford to do at once, and this system gives them a profit besides. On the other hand, many estancieros in the south and middle of the province of Buenos Aires are finding it so profitable to raise wheat that they are renting their land to colonists for wheat or are putting it in themselves, rather than use it for stock. In other parts of the same province they say that 1 to 1¼ animals per square (4.17 acres) is the capacity of the native grasses. In the same place the estimate of the alfalfares is 3 animals per square for six to seven months out of the year, as in winter there is not much alfalfa to be had. In the province of Santa Fé the native camps vary widely, but in the southern part, which is best, the native grasses can be relied on in good seasons for about 1 to 1¼ animals per square; but when the

dry cold season comes on, the cattle do not do well on this feed. Alfalfa in the same district will fatten 3 to 5 head per square in five to eight months, depending on the condition of the cattle when they reach the place, and the nature of the season—whether the alfalfa is in prime condition or needing rain. In the province of Buenos Aires, where they have alfalfa, it usually does not endure feeding well, except in certain exceptional parts. The native grasses are more relied upon, as they are much better there than in the upper provinces. In Córdoba and Santa Fé they are forced to put in alfalfa, as otherwise the camps would not be stocked, except with inferior criolla, or native, cattle.

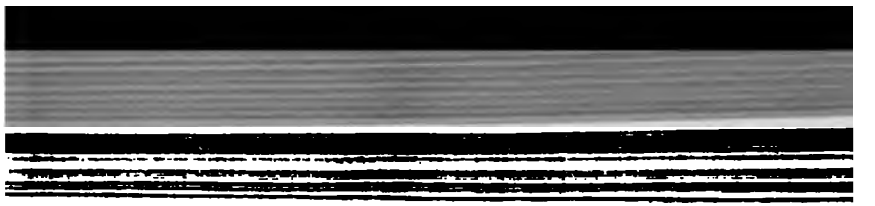
As a general rule, in the majority of cases, little or no provision is made by estancieros against the usual annual dry season in the winter or for extreme droughts, and the cattle suffer accordingly. Of course, there are many exceptions to this improvidence, notably in the older and more valuable inside camps, and the success attained by the men who have taken the better care of their stock during the cold and dry seasons have done much to teach the necessity and profit of preparing to give stock dry feed during times of drought, and to finish steers on grain. Cheap, frozen, grass-fed beef will, of course, continue to be sold in England, but for export alive and for chilled beef of the best quality, alfalfa or the native grasses alone will not produce animals that will command high prices.

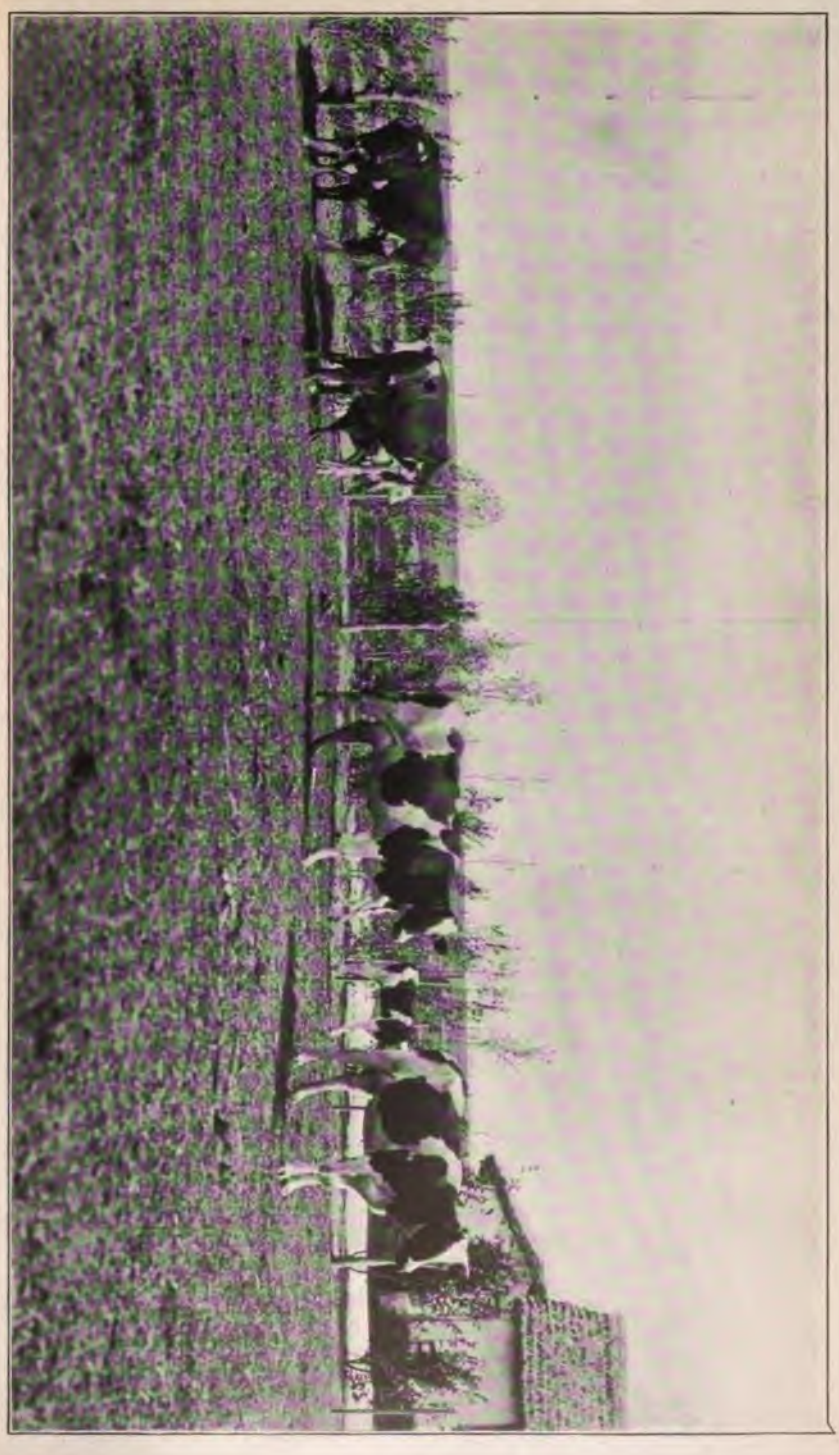
ADVICE OF AN ARGENTINE PACKER.

Mr. Daniel Kingsland, manager of the new chilled-meat works in La Plata, near Buenos Aires, has just issued a circular to estancieros giving them advice as to the best kind of animals to meet the demands of the chilled-meat trade. His suggestions have added importance from the fact that he is an old resident of the country, a producer of beef animals himself, and knows the conditions and possibilities of the country well. In his circular he says:

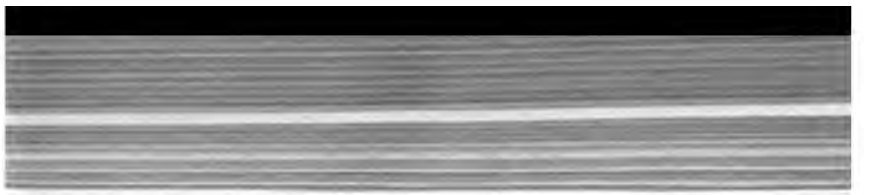
With regard to cattle, the export of beef in a refrigerated or chilled state to the United Kingdom is now an accomplished fact, but is still in its infancy, and places this country in the position of being the principal competitor of the United States of North America, which has hitherto enjoyed the whole of this trade. To compete with them successfully, it is our opinion that great care should be taken to produce bullocks which will always be worth more for this purpose and command a higher price than for any other. For chilling, it is not necessary to send extremely heavy weight cattle. Bullocks of two and a half to three years old, well finished, and weighing from 550 to 620 kilos, or an average weight of 580 kilos (1,213 to 1,307 pounds, or an average of 1,278 pounds), will command the best prices. To produce this article from the average well-bred mestizo (graded animal), now plentiful, it does not matter whether the cross is Durham, Polled Angus, Hereford, Red Lincoln, or any other meat-producing strain, so long as the animals are always well fed and looked after in the winter season, when grass is scarce, or any other time when there should be a shortage of feed, never allowing the animals to become poor. This can be done by always growing a certain amount of alfalfa, corn, or other foods for winter

GRADE SHORTHORN BULLS, 2½ YEARS OLD, SECOND-PRIZE LOT. SOLD AT AN AVERAGE OF $1,731.





Holstein Cows and Calves. Prize Winners in the Dairy Test.



feeding. By doing this estancieros will have no difficulty in producing the animals required all the year around, and the results will be satisfactory to themselves. The trouble and expense of cultivating a small proportion of their land in order to provide food for the winter and fattening stock in bad seasons will be well repaid.

Concerning the production of lambs for export, Mr. Kingsland says:

The production of lambs for export shows the greatest room for improvement, and should give good results to those who undertake to produce the suitable article. This can be done by introducing meat-producing strains of sheep into your flocks, such as Hampshire, Southdown, Oxford, Shropshire, and also Border Leicester rams, and, for the low camps, Romney Marsh rams. Then by winter feeding the ewes, enabling them always to have plenty of milk for their lambs, they would fatten at from five to seven months old to average 30 kilos (66 pounds) live weight, and would be worth 10s., or even more. Lambs intended for export should never be shorn, as it throws them back, and the wool obtained barely covers the cost of shearing. By producing lambs and selling them at this age, you are turning your capital every year, and therefore doubling your producing powers. The following facts will show you how far we are behind New Zealand, which country is our chief competitor in the frozen-sheep industry: The total number of sheep of all classes in New Zealand last year was about 20,000,000, and it exported nearly 4,000,000 of frozen sheep and lambs. At the same time we had 100,000,000 sheep in this country and our export was only 3,500,000. These figures speak for themselves, and should be an object lesson as to the possibilities in the production and early maturing of fat lambs; and it has also had the effect of increasing the value of, and extending the demand for, land suitable for the production of lambs to a very great extent. We would strongly advise estancieros to lay themselves out to prepare a certain number of lambs for export every year. The results must be of the most satisfactory nature to them and will increase the value of the flocks and camps all around.

LIVE STOCK CENSUS.

No one knows how many cattle there are in Argentina. Authorities disagree in their estimates, but it is now quite generally admitted that the estimates that have been given during the past two or three years are too high. The last regular live-stock census, taken in 1895, compared with the previous one, taken in 1888, is as follows:

Live-stock census of Argentina, 1888 and 1895.

Kind of animals.	1888.	1895.
CATTLE.	*Number.*	*Number.*
Criollos (native)	17,574,572	14,197,159
Mestizos (graded)	3,388,801	4,678,348
Purebreds	37,858	72,216
Milch cows	960,426	1,800,799
Oxen for service		953,004
Total	21,961,657	21,701,526
HORSES.		
Work horses	1,043,379	4,016,297
Criollos (native)	2,926,687	
Mestizos (graded)	259,009	414,985
Thoroughbreds	4,957	15,577
Total	4,234,032	4,446,859

Kind of animals.	1888.	1895.
SHEEP.	*Number.*	*Number.*
Criollos (native)	24,322,214	17,938,061
Mestizos (graded)	42,002,871	56,106,187
Purebreds	381,012	335,314
Total	66,706,097	74,379,562
Total live stock:		
Cattle	21,961,657	21,701,526
Horses	4,234,032	4,446,859
Sheep	66,706,097	74,379,562
Pigs	393,758	652,766
Asses and mules	417,494	483,369
Goats	1,894,386	2,748,860

Statistics just published by the bureau of statistics of the department of agriculture, covering about three-fourths of the country, show that where in 1895 there were 16,256,363 cattle, there are now only 15,446,852, a decrease of 5 per cent. The correctness of these figures has been challenged, and the bureau of animal industry is arranging to take a census that will be more reliable. Still, it is well known that there is a much less number of cattle in some parts of the country, notably in the southwest and in the north. Droughts, overstocking, garrapata ticks, foot-and-mouth disease, and anthrax have carried off many thousands. Cows have been sacrificed, thus interfering with the natural increase, until the Government is planning, as previously explained, to take steps to stop it. Younger animals are being sent to market also. The most conservative estimates do not place the total number of cattle in the country at more than 24,000,000, though it must be admitted that it is most difficult to arrive at a safe estimate or to find a sure basis to figure on.

Estimates on the number of sheep, based on the amount of the clip, on known conditions, careful reports from the sheep sections, and intimate knowledge of the business, vary from 80,000,000 to 115,000,000. It is probably fair to conclude that the real number is a little below an average between these two figures.

EXPORTATION OF LIVE STOCK.

During January, February, March, and April, when the English ports were open to Argentine live stock, the number of animals exported was:

Exports of live stock from Argentina, January to April, 1903.

	Cattle.	Sheep.	Horses.	Mules.	Asses.
January and February (chiefly to England, South Africa, Brazil, and Spain) [a]	11,926	48,663	1,234	7,388	3,267
March:					
To England	10,319	29,203	34	.....	.....
To South Africa	959	12,880	150	74	5
To other countries [b]	264	3	27	.....	.....
Total	11,542	42,086	211	74	5
April	12,877	44,105	529	907	30

[a] English ports open to Argentine live stock February 3 and closed May 9, 1903.
[b] The actual totals for March from revised returns were: Cattle, 13,594; sheep, 17,931; horses, 62; mules, 89; asses, 30. Destinations are not given.

The average weight of the steers exported is given at 1,462 pounds.

Considerable complaint has been made by the exporters of live stock about the delays and expense of the inspection, disinfection, and fittings required by the Government for the exportation of live stock. But no doubt these will be overcome in time. The Government appears determined to use all possible precautions to prevent diseased

animals from being exported and to provide that the animals shall have such care on the voyage as that they shall arrive at their destination in good condition.

The results were not what had been expected, for various reasons. A great majority of the cattle that did not do well on the voyage were wild, untamed brutes. They were bruised and frightened in the railway cars coming to Buenos Aires. Arriving there, they were unaccustomed to such close quarters, did not know how to eat dry food, and, being hustled about and lifted on board in great cages high in the air, they were still more frightened. On board they knew still less how to adjust themselves to their new surroundings, failed to eat, were probably not so well cared for as they might have been, and some very heavy losses resulted. One ship was out twenty days longer than expected, and the animals had little to eat. Several lost from 20 to 30 per cent of the animals on board, and those that got through were in bad condition. The sales ran from £12 to £23 ($58.32 to $111.78 U. S.) in the English markets. Several cargoes were sold at £12 to £16 ($58.32 to $77.76 U. S.), which meant heavy losses. The animals cost in Argentina from £8 to £11 ($40.88 to $53.46 U. S.), generally about £10 ($48.60 U. S.). The ocean freight was from £3 10s. to £4 10s. ($16.91 to $21.87 U. S.), the former being the lowest rate at the time the ports were closed (May 9). The rates for sheep were 6s. a head. Then there was the cost of feed and care besides, so that £18 ($87.48 U. S.) was the lowest price that gave a profit. Rates to South Africa were £4 ($19.44 U. S.) for cattle and 6s. ($1.44 U. S.) for sheep. To Para, Brazil, where a small but regular trade in cattle has been worked up, the rate is £4 10s. ($21.87 U. S.) per head. The ships used in the trade are not specially adapted to the business. There was lack of proper ventilation, the fittings were not always what they should have been, and, in fact, the business was just being learned and better ships were being offered when the foot-and-mouth outbreak put a stop to it for a time.

But the chief lesson learned by Argentines in their latest experiment with cattle exportation was that they must abandon their hopes of getting prices equal to those obtained for the prime corn-fed steers from the United States unless they also feed their animals grain to finish them for market. They also learned that a wild animal will not come off the range, take a railway journey, and go on shipboard and travel four weeks unless he has been prepared for it by taming and feeding before he leaves the estancia. So we may expect to see the Argentine estancieros begin within a year or two to put grain-fed steers on the market, but not in large numbers.

HEALTH OF LIVE STOCK.

Aside from the anthrax, which is still very bad in the province of Entre Rios and in certain parts of the province of Buenos Aires, and

the garrapata, or Texas fever ticks, which infest the northern provinces, the health of the cattle is good. The foot-and-mouth disease, referred to elsewhere, is regarded as a very small affair that will soon be ended so far as the better part of the country is concerned. The past season and the present one have been favorable to the health of cattle, except in a few places, where they have suffered from severe droughts. The Government is making a brave effort to confine the ticks to the warmer sections, where they are thickest, and to prohibit cattle from coming south beyond a certain point.

For many years cattle have been brought down from the Chaco and other parts of northern Argentina to be fattened on the rich camps of the provinces of southern Santa Fé, Córdoba, Entre Rios, and northern Buenos Aires. It has been a very good business, for the producers of stock cattle on these cheap northern camps could afford to sell their stock at very low prices. The cattle were immune from the fever, though carrying plenty of ticks. In this way some of the best stock regions were infested with ticks. But those who brought these cattle down, paying $15 or $20 for 2-year-olds, keeping them on grass for a year or so, and selling them at prices ranging from $35 to $60, strongly objected to having this business interfered with. The question was discussed for several years before the Government finally established a line and required the cattle crossing it coming south to be dipped. It was made compulsory to use a certain dip, and that was another source of controversy, the claim being made that other dips were equally good. But the Government authorities insist that their dip is the only one that will actually kill the ticks, while other dips simply cause them to drop off the animals. The establishment of this line affected the saladeros, or jerked-beef factories, the shipment of fat steers to Buenos Aires, and the bringing of steers down from the north to fatten. In the province of Entre Rios, where the saladeros are located, the movement of live stock furnished a large part of the provincial revenues, and its partial curtailment inflicted hardship on the provincial government. It is generally claimed that the official dipping stations are wholly inadequate. The animals are submerged one at a time in a cage let into the bath by a sort of derrick. It is impossible to dip more than 200 or 250 per day of these wild animals. All sorts of objections were and are still being raised. Besides, many stockmen regard the whole thing as nonsense and claim that the ticks do not carry the Texas fever. Several postponements of the taking effect of the decree were made, but it finally went into operation on April 1, 1903. During that month it was suspended, so far as Entre Rios was concerned, until July 31, under an agreement with the provincial government that it would cooperate with the Federal Government at the end of that time in putting it into full force. The provincial government is to erect enough dipping

stations to accommodate the demands. The Minister of Agriculture has just refused to further extend the time when dipping will be required.

THE SHEEP BUSINESS.

During the first six months of the year 1902, and in the latter part of 1901, the sheep business in Argentina was very discouraging and the Argentines, always quick to take up a promising new thing and just as quick to run from it when they strike a bad season, began to sell their sheep for nearly nothing. Sheep could be bought by thousands for $1.50 to $2 and many were sold for $1 paper, or from 45 to 90 cents gold each. Various causes contributed to this, but the low prices of wool and mutton were the chief ones. The British ports were closed to live sheep and the freezing companies paid what they pleased for fat wethers and lambs—usually from $4 to $6 paper, rarely more than $5.50. The best wools were selling at 15 to 20 per cent less than now. The home demand for mutton was not sufficient to make a price better than $2 to $4 in Buenos Aires. The coarse Lincoln wools especially were not in demand and were being shipped in great quantities to the United States for carpet manufacture. Now the markets are better for both wool and mutton and a change is coming over the Argentine flocks. This was one of the most striking features of the great annual show, and it points to conditions that offer to the sheep breeders of the United States an opportunity to make some sales of Rambouillet and Merino rams. Of the 1,718 sheep exhibited and offered for sale, 955 were Lincolns, but they did not, as heretofore, bring the highest prices or command the most interest. The Down breeds, the Rambouillets, and the Merinos were more sought after, in proportion to their numbers, and their numbers were greater than in any previous show. It will be noticed that the Lincolns stood third in the average price of sale, closely pressed by the Oxford Downs. The prices were not so high as in 1901, when the champion Rambouillet ram sold for $7,300, and this year it sold for only $2,000. But the highest priced Lincoln was only $1,600. In a later sale in January a group of 4 Lincolns sold for an average of $1,750, the highest price being $2,300.

In this sale (January 21, 22, and 23) 383 rams, mostly shearlings, from 16 to 28 months old, were sold with the following results:

	Average price.
267 Lincoln rams, purebred	$206.53
75 Lincoln, grades	46.13
41 Black-faced purebred rams	121.27

Highest and lowest prices of principal breeders.

Breed.	Owner.	Number sold.	Highest.	Lowest.	Average.
Lincolns	Puchuri & Co	4	$2,300	$1,300	$1,7[illegible]
	Mendiberri	5	770	340	47[illegible]
	Espartillar	20	1,200	170	29[illegible]
	Cec. Lopez	7	600	150	39[illegible]
	Manuel José Colo	4	500	320	38[illegible]
	B. Gimenez Paz	8	480	170	24[illegible]
Hampshires	Hector F. Casares	.....	200	100	.....
Oxford Downs	Leonardo Pereyra	.....	320	200	.....
Shropshires	.....	.....	160	100	.....

With the exception of the Puchuri and Mendiberri lots, these were the second picking of the flocks, the best having been sent to the Palermo show the previous September. These two breeders did not exhibit at Palermo. With these exceptions the animals were, on the whole, inferior to those shown at Palermo, especially the Downs. The following is from the manager of the largest live-stock auction house, whose opportunities for studying the needs of Argentine breeders are unsurpassed:

In my opinion this year's tendency has been toward the Black-faced sheep, the Downs, a tendency which is likely to grow until the breed impresses itself upon the country over the Lincolns and Rambouillets, just as in former years the Lincolns imposed themselves against the Merino types. The reasons for this are early maturity, hardy constitution, quality of meat, and equal price for wool. These are the same conditions which in other times secured superiority for the Lincolns, a superiority which has commenced to vanish on account of the excess of production. I attribute this evolution of breeds less to a distinct superiority of any of them than to the influence—the inexorable law—of supply and demand upon production. Experience in breeding, combined with a clear insight into the special requirements of camp and climate for each of the improved breeds, will bring forward the good qualities they all possess.

The objection of the exporters to the big Lincoln, both on the hoof and as frozen mutton, has had a great influence upon the breeding of a better mutton, one that gives a smaller, firmer, leaner meat. The overproduction of the coarse Lincoln wool was the other strong influence, although this season there has been some improvement in the price of Lincoln cross wool. The opinion is quite general in the country that the breeding of Lincolns has gone too far, and that a better mutton and a finer wool must be produced. So the Downs, the Blackfaces, are being sought for, especially the Oxford Downs, and also the Shropshires. The demand for Rambouillets is still strong. As it is now forbidden to bring rams or any other live stock from Germany or any other part of the Continent of Europe, and as the Merino types are again being sought after, it is plain that this is the time for our breeders to send their best animals to this country, just as they did

many years ago, when the first Merinos were brought to Argentina from Vermont.

Several hundred Lincoln rams have already been imported from England, and are being, or have been, sold at auction. The prices were very good, one lot of 20 rams and 10 lambs averaging $908 each for the rams and $302 for the lambs. Another lot of 6 averaged $1,175; one sold for $3,000. Ten ram lambs averaged $237. Another lot of 4 averaged $314. Among the arrivals from England were 54 Shropshire rams and 62 Shropshire ewes; also 15 Hampshire Down rams, upon order. This breed is quite extensively used in Argentina.

The Shropshires brought only about $250 paper each at the first sale, and a second sale only $100 to $160. The demand was quickly supplied.

The freezing works pay a higher price per pound of dressed meat for the smaller, finer mutton sheep than for the coarse, large Lincolns, because the latter meet with objections in the English market, where for several years they have sold for a lower price than the smaller carcasses. One of the largest frozen-meat concerns in the country grades its lambs and muttons into the following five classes: No. 1, 34 to 39 pounds; No. 2, 40 to 48 pounds; No. 3, 49 to 56 pounds; No. 4, 57 to 64 pounds; No. 5, 65 to 72 pounds.

The 50 to 56 pound carcasses are preferred, so the sheep that will dress nearest to that weight and furnish a good quality of mutton is the one that commands the highest price. The opening of the English ports is, of course, emphasizing this preference for the smaller mutton sheep, creating a much larger demand for the wethers. This will encourage the breeders of the Downs, the Merino types, the sheep of smaller, finer carcasses and finer but lesser weight of wool. Still, the improvement in prices of Lincoln and Lincoln cross wools this year has encouraged the Lincoln breeders, already so greatly in the majority; and Lincoln rams are still in strong demand, as shown by the successful sales of those recently imported from England.

The sheep market in the suburbs of Buenos Aires is a great national institution, under private management and well directed. Here most of the sheep in the Republic are sold, although many are sold on the estancia, much the same as cattle—that is, the better class of export lambs and muttons. Prices vary greatly, according to the quality and weight of the animals, the amount of wool they carry, the demands of the market at the time of purchase, the distance from Buenos Aires, etc. All sheep are bought by the head, as are cattle.

The price of the export type of mutton sheep has been going up for several months, more noticeably since the opening of the English ports to Argentine live sheep. The top price now is $12 per head for the best export wethers. The daily prices in the Buenos Aires mar-

ket range from $6 to $12 for fairly good animals, though many are sold for less. They are inferior animals, however. All the really good ones bring from $8.50 to $11.50. These prices are about double those of a year ago. The higher prices are for the product of well-known estancias, in large numbers, where the animals are more uniform and of exceptional quality. The prices vary from 11 to 16 cents paper per kilogram live weight, the average at this time being about 15 cents. This is equivalent to a range of $2.18 to $3.20, or an average of $2.97 gold per 100 pounds. The distinction made by the frigorificos is that they pay more for the small sheep of fine mutton than would be warranted if size only was the consideration, as compared with the price paid for the big Lincolns. The latter, however, give a greater quantity of wool, and, though the mutton price in England is lower, there are more pounds to sell, so the man who raises it can afford to take a lower price per pound. For these reasons, although the Lincoln will stand less hardship than the smaller breeds, his champions in Argentina are not deserting him altogether.

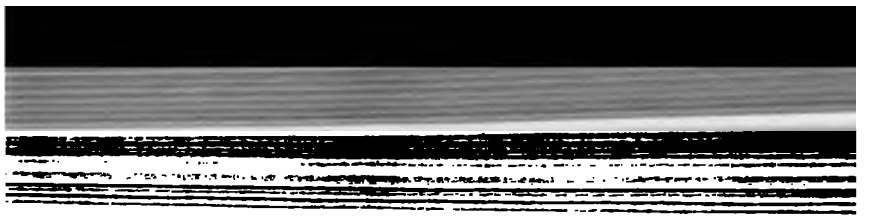
THE EVOLUTION OF THE SHEEP-BREEDING INDUSTRY IN ARGENTINA.

There is no better authority on sheep breeding in Argentina than Mr. Herbert Gibson, vice-president of the National Rural Society. His father before him was a sheep-breeder there also, and his interests are chiefly concerned with sheep, as importer of purebred rams, breeder of breeding stock for this country, producer and purchaser of wool, and producer of mutton. A few years ago he published a book, "The History of the Sheep-breeding Industry in the Argentine Republic," and it is considered an authority to-day, except as subsequent developments have changed the conditions in the country. Mr. Gibson was most active and prominent in the introduction of the heavy, long-wooled Lincolns into the country twenty years ago, and urged the crossing of the Lincoln on the smaller Merino breeds for the double purpose of producing the greatest quantity of wool and mutton.

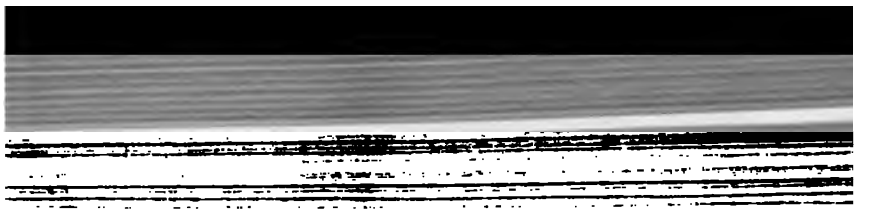
For these reasons importance must be attached to the recent publication of an article in the Anales de la Sociedad Rural Argentina, the official organ of the Argentine Rural Society, by Mr. Gibson, in which he distinctly modifies his views regarding the Lincoln breed. The fact that this article, written by the best-known writer on the sheep industry and one of the foremost advocates of the Lincoln, appeared in the chief agricultural and pastoral publication in the country, is the best evidence to be had of the great change that is now taking place in the sheep industry of Argentina. The article will be found to be of the deepest interest by all who in any way deal in mutton or wool, for it is based on long and thorough study and experience and is the verdict of a man completely convinced against his will, who

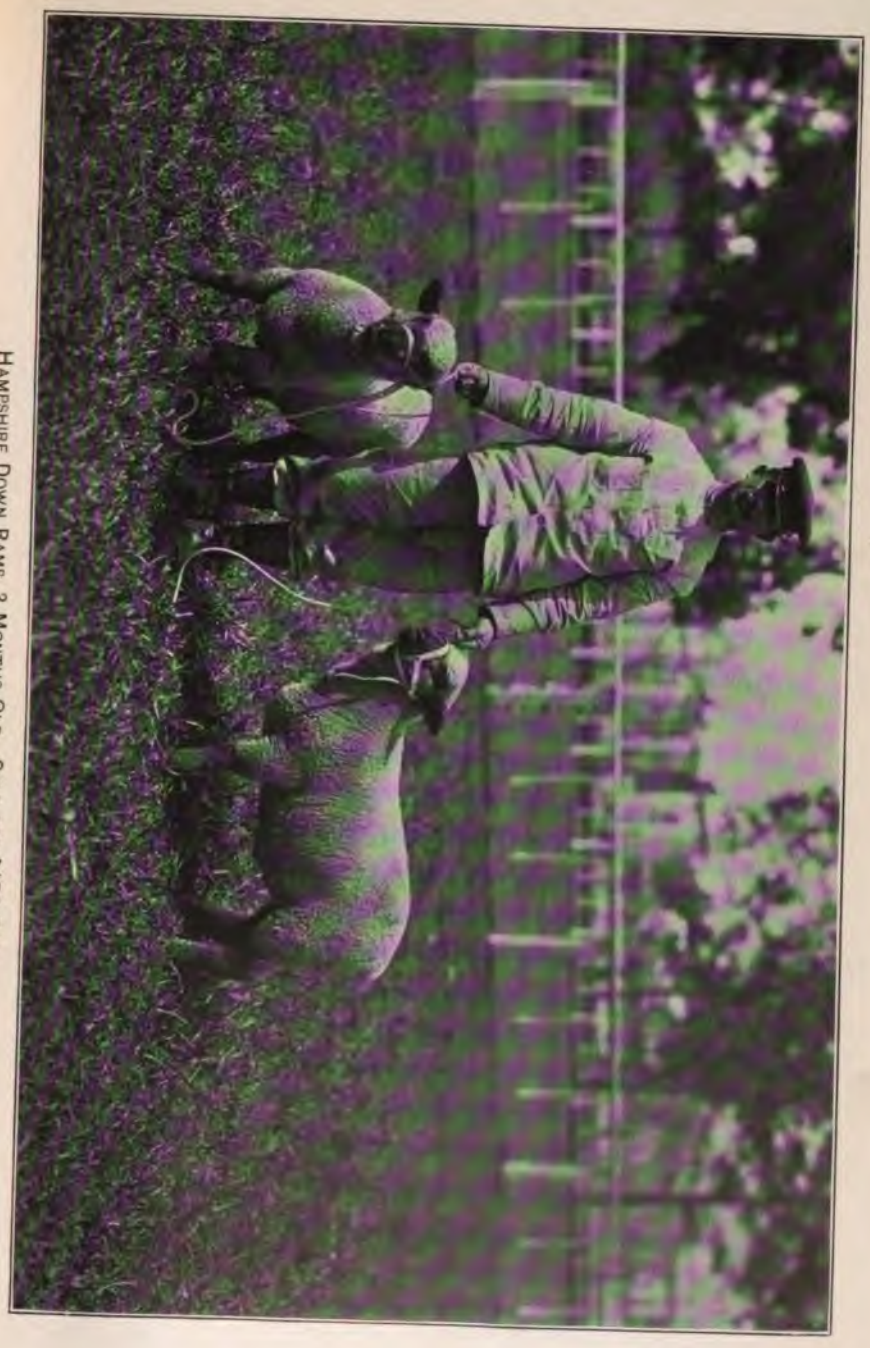
FIG. 1.—FIRST-PRIZE YEARLING LINCOLN SHEEP. SOLD FOR $1,350.

FIG. 2.—FIRST-PRIZE HAMPSHIRE DOWN RAM.



SECOND-PRIZE RAMBOUILLETS, 18 MONTHS OLD. THREE SOLD AT $530 AND ONE FOR $2,000.





Hampshire Down Rams, 3 Months Old. Sold for $150 Each.

gives the reasons that have changed his opinions. The following is a translation of the article in its entirety:

The notable presence of the Down type in the recent exposition of the Rural Society shows a significant fact. The sheep industry of this country is about to enter upon a new evolution. The supremacy of the Lincoln race belongs to the history of the past. But it will not resign its empire without preserving the feudal titles which belong to it by right and tradition. Hence it is to be concluded that the Lincoln breeder who writes this, on welcoming his competitors, is not disposed in any way to quit the field.

After sixteen years of continuous demand for wool and carcasses of the Lincoln cross—every time less cross and more Lincoln—we find ourselves to-day with the British ports closed,[a] the coarse wool despised, and our market limited to the demand—not very encouraging—of three freezing establishments. The time has therefore arrived to balance accounts with the sheep industry, and I now make some observations which this state of things will have suggested, without doubt, to more than one breeder.

First. The production of crossed wool, fine and middling, diminishes in my flocks. Every time there is more coarse wool. The more I try to mark my flock with the seal of the Lincoln the greater is the amount of wool "de padres" that my consignee rejects. What I mean is that the producer and consumer are going in opposite directions. When I think that my labor will be rewarded and exhibit a Lincoln flock typical and uniform, my consignee rewards me by sending my wool to make carpets in North America.

Second. It seems that it is not enough that my wool is valued in an order inverse to the refinement of my flock. The meat market acknowledges still less the merit of so many sacrifices. Even before the closing of the British ports the exporter talked to me about the mutton of the Lincoln type as being too pronounced, too large, too heavy. As soon as the demand was limited only to the market of the freezing establishments the diminution of value of the Lincoln mutton was more accentuated than ever. After twenty years of laborious progress I have seemingly achieved the result of producing a mutton whose only destiny is the grease tank.

Third. To these tribulations there is another to be added—that of the worm. It is noticeable that when you have succeeded in establishing a remarkable Lincoln type in the flock, that is the time this worm causes the greatest damage. There is a predisposition on the part of the yearling lambs to fall victims to *Ovine pasteurolosis* and to succumb to its effects. The spring brood experiences more and more every year a notable decrease during the dry and hot months of the following fall. Our afflicted shepherd will surely not find a ready and easy solution of the problem which confronts him; and if some of the causes that have contributed to this painful situation are marked out, it depends on the ability of each individual to apply them to his own case and to determine which modifications ought to be introduced.

The good prices obtained during the last decade for the wool and mutton of Lincoln cross have induced us to overstock our ranges with sheep. This was a great mistake. It is not enough that during certain periods of the year sheep are fat if at other times they are insufficiently fed. This overstocking has brought what the English call "dirty pasture," and consequently the scale of mortality increases.

The true Lincoln type has experienced a modification in this country, owing to the demand for size. Its fleece has lost the uniformity which characterized it twenty years ago. Its form has been exaggerated. The purity of the type has been somewhat sacrificed in order to obtain a large quantity of meat and volume of wool.

[a] November, 1902.

Vigor and vitality—qualities necessary to transmit in their purity to the breed—have been sacrificed in this way.

A ram born and bred in the stable, artificially fed from its birth and forced to a precocious development, can not transmit to its descendants the qualities of robustness necessary to our system of sheep breeding. The English breeds do not owe their good reputation to measures taken against nature, nor have their typical qualities been produced in this way, and the practice in our breeding establishments, whose only object is a great development, is too artificial. It is true we ought not to neglect the breeding animals destined for the exposition, and we ought to feed them with the best fodder, keep their fleece in the best condition, and put into practice every legitimate art to present them in the most perfect way before the public. But it seems only reasonable, nevertheless, to allow them at least to breathe the pure air of the field and not the heavy atmosphere of a half-closed and half-dark stable, to oblige them to walk and to graze, and lastly to always keep in mind in preparing them that the breeder produces wool and meat in God's pastures and not in a factory lighted with electric light.

Passing over the causes why the Lincoln breed has not given all the results desired by its advocates, we come to another condition of our national flocks, to wit, their tendency toward unification. No one will deny the beneficial results of crossing the half-breed weak Merino with the robust Lincoln, to whose blood we are indebted for the improvement of form, the firm and healthy basis, and the rugged constitution which contribute to strengthen our sheep in the struggle against the open-air life and the climatic, topographic, and economical conditions of our system of sheep breeding. But the law of compensation is applied to stock breeding as well as to other industries. We ought not to seek either the one or the other extreme, but a medium. The demand of the market does not justify the production of an exaggerated specialty, because in order to obtain this specialty it is necessary to sacrifice certain qualities for the benefit of others, and sooner or later defects appear. In this respect the Lincoln breed has, or, to speak more correctly, had grown too popular.

The stock-breeding economy, as well as all others, is an unending history of ingrafting. The law of nature marks the step, always modifying, always molding, always surprising us with her evolutions, always reminding us while we painfully advance through the way of progress that man lives by the sweat of his brow and putting in our way obstacles which subdue our pride at the very moment when we thought we had reached the summit of our ideal. But, as she is also a good mother, she relieves our affliction by showing another way, until then unknown to us, by which she allows us to progress again, to advance, and to hope.

To ingraft, or, using breeding terms, to cross the typical features of the breeds that are crossed is a prime consideration. It is well known that consanguinity marks its procreation with all the characteristic conditions of the progenitors, be they good or bad, and that consanguinity has been the means employed by the breeder to reproduce the type he wished to perpetuate. In the crossing of the breeds, the greater the typical purity of the progenitor the greater is the perfection reached in the offspring. We start, then, if we intend to cross again, from a basis surer than the one of twenty years ago. The coarseness of the mixed Lincoln flocks of the country shows a condition more rational, more typical than the mixed Merino flocks showed then. We rely on the existence of a stock of rams of the Rambouillet, Lincoln, and Down breeds that will supply the demand for sires of excellent pedigrees. The national sheepfold is well equipped. There are elements to modify, in a satisfactory way, the existing sheep.

But outside the modest ability of the breeder who writes these lines, it surpasses the limits of an article to explain in detail the process through which our national flocks will approach more nearly to a profitable medium and to the balance of production, which is so evidently lacking. In the first place, we ought to realize better

the limitations to which we are subjected by the climatic and topographic conditions of the regions in which we raise our sheep. It is probable that the sheep breeder situated among the tender natural pastures of the South, in the climate of frequent and copious rains and damp atmosphere, whose flock of accentuated Lincoln type does not increase in the value of wool and meat, would find it advantageous to do what in New Zealand has given such satisfactory results, viz, to cross his Lincoln with Romney Marsh. The Kentish sheep contributes to impart smoothness, thickness, and to a certain extent fineness to the fleece of coarse Lincoln, while the meat of this crossing is in good demand, and a greater constitutional robustness is noticeable in the offspring.

The breeder with alfalfa pastures will never be a great sheep breeder. His rôle is in the cattle business. The development of the sheep industry on the alfalfa stock farms is incompatible with the production of fine wool, of whatever breed, either Merino, or Lincoln, or any other. The problem for the man with alfalfa has but a single economic side—to produce the best and greatest quantity of meat and to find out the type which will best answer this question only.

While the freezing establishments and the exporters of live sheep do not reward quality, paying for an animal of the Down cross a price greater than that paid for an animal of Lincoln cross, it is to be expected that the breeder will always prefer the animal of greater weight. But there are reasons for thinking that this will not always be so and that the Down breeds, crossed on the flocks of Lincoln origin, are destined to modify the general type of the flocks in the alfalfa regions.

In the outlying ranges of the Southwest—the zone of scanty rain and dry atmosphere, separated by long distances and expensive freights from the meat markets—the production of fine wool approximating to the Merino should be the first purpose of the breeder. The long wool of the English white-faces does not prosper there. The conditions of the climate favor the Merino breed. With the opening of a nearer meat market, with the improvement of the virgin range, and the planting of artificial pastures the meat production of that zone might become a more important factor than it is to-day. In this case the breeder will experience another process of evolution, seeking from among the meat breeds whose fleece is the most like the Merino—perhaps the Shropshire—a new cross which will make his flock a source of greater profit in the production of mixed products.

The Argentine breeder needs an increasing number of establishments in which the typical breeds of his specialty are produced. The pure, crossed, or mixed sire will disappear in time, to be replaced by the genuinely, genealogically, typically pure sire. The sheep breeder is called upon to produce, at a moderate price, for the wholesale sheep raiser a flock ram for the general flock, of a type and condition distinctly generic, who will not only give sons, but sons like himself. This will promote the union of the national flock, whose production will improve the more it approaches the medium of the distinctive qualities of each breed. But no breed, no crossing, will permanently contribute to the improvement of the flock if the breeder is not first imbued with the principles of economy. Before finding fault with the Rambouillet, or the Lincoln, or the Down, it will be well to think about the economic system of the farm. In our eagerness to produce much, and of the best, we have exacted more from the soil than the soil could give. The pastures have been overcharged with sheep; the richness of the soil has been exhausted, and the epidemics of worms and other like tribulations that persecute us are but the silent protest of nature, whose fertility has been prostituted.

A good friend of the Argentine Republic, the late John Nash, of good memory, importer of purebred animals, and one of the pioneer stockmen in the alfalfa region of the province of Santa Fé, used to say that half of the crossing of breeds in stock enters through the mouth. We are not yet ready to dispense with these rustic aphorisms of the old world. If we want to obtain better incomes, better fleeces,

better carcasses, we must not forget that the most classic ram in existence was not a beauty of Divine origin, but that he had once, in a period more or less remote, ancestors as vulgar, as inferior, as common as a bull of the wild herds from the Falkland Islands. There is no royal road to the perfection of cattle or sheep. We follow a path obstructed at every step by disappointments and unexpected obstacles. The improvement of the domestic breeds is a slow process which never reaches completion. We need not only intelligence and theory, but a continuous, indefatigable method adapted to the country—throwing now and then a glance toward the past—if we want to be able to say we progress.

ARGENTINE RESOURCES SHOWN BY EXPORTS.

The importance of Argentina as a food producer for other parts of the world across the sea is yearly coming to be better understood, as she sends more wheat, more corn, more beef, more mutton, and more butter nearly every year than the one before. And the Argentines and those from other lands who have been attracted to Argentina by the richness of the country and its boundless possibilities are getting a better understanding of their opportunities and how to make the best use of them. For the most part, however, the native Argentine, the descendant of the older families, prefers to confine his efforts to stock raising, agriculture, and politics, leaving the development of trade, of industries, and most commercial pursuits to foreigners. Naturally, the foreigners' profits in developing Argentine resources have been large. The freezing companies that send frozen beef and mutton to England, South Africa, and other markets have been earning 40 per cent dividends. There is a large margin in the butter business. Fortunes have been made in grain. But these conditions are not always to prevail, and, indeed, are changing already. There is a new generation in which there is much new blood, and these young men are ambitious to do more than raise stock and get into the provincial or national legislative bodies or hold some other official post.

Last year the Argentine energy in hunting markets was shown by the manner in which they went after the South African market. The Argentine department of agriculture rented a big transport from the navy department and sent several experimental cargoes to South Africa. They took mules, steers, horses, butter, alfalfa, wheat, oats, sheep, and many other things in small parcels on the owners' private account. It was all sold to good advantage, and convinced both shipowners and producers that the market was worth working for. Now there are three regular shipping lines, with frequent sailings, and a good trade has sprung up. Some of the trade has not turned out so well as was hoped, but the experimental cargoes, sent at the lowest possible cost to shippers, have built up a trade that would not have been developed otherwise, and which is worth many thousands of dollars every month to the Argentine producers of food products, alfalfa, etc.

The British ports were closed to Argentine live stock during all the year 1902, and also in 1901, owing to the foot-and-mouth disease which was so severe in the year 1900. This had been the chief market for Argentine steers, wethers, and lambs. Notwithstanding this, the exports of live animals during 1902 amounted to $5,617,696 gold, an increase of $2,532,941 over 1901. Of this increase, $1,033,800 was for mules, most of which went to South Africa. That was only a temporary business, for the trade is now back to its normal condition. In 1899 Argentina exported 312,150 steers, nearly all to England. Last year she sent 118,303 to various places, and this was nearly all new business, worked up in the last two years. It was 886 fewer than were exported in 1901, but the prices realized amounted to $868,073 more in 1902. These cattle went to Spain, Portugal, South Africa, and Brazil. They were not equal to the best type of export steer that Argentina sent to England this year, but the business made better prices for a fair type of steer.

With the British ports open to the steers and sheep of Argentina, it is the ambition of every producer of steers and mutton sheep to raise animals that are fit to meet the demands of the export market. If he has rather bad luck at first in trying to compete with the United States, it only drives him to the improvement of his product to meet the conditions of the market in which the best prices prevail. That he will do this there is not the least doubt, for he has all the facilities for doing it. With cheap land, cheap labor, and a climate so favorable for the production of corn and other feed, and so kind to stock that they need no shelter the year around and are almost sure of abundant green feed during every month in the year, it will probably not be long before as good steers will be produced there as can be produced anywhere.

Gains are shown in the exports in nearly all important lines except wheat, flour, and wool. This year the corn crop will be almost double that of last year, and all the estimates of exports double the amount of last year, or nearly so. The wheat crop also will be very much heavier, probably double, as the crop of 1902 was far below the average. Wool exports this year are, up to the 1st of May, less than the same period last year, but the prices are much better. The year, in short, is a most prosperous one for the Republic. Crops generally have been good and prices are satisfactory. So are the prices for cattle and sheep, and the demand is putting the prices up a little more every week for good fat wethers, till now they are worth $12 paper for the best.

The Argentine Government collected $3,210,307 gold in export dues in 1902, of which all but $29,850 was on animal products. The following export products are taxed 4 per cent on their gold valuation as fixed by the current market prices: Wool, all kinds of hides and skins,

horns, horsehair, tallow, animal and fish oil, bone ash, hide clippings, bones, hoofs, ostrich plumes. Old iron pays 5 per cent, and all other products are free.

PRINCIPAL EXPORTS FOR FIVE YEARS.

The following table shows the principal exports of animals and animal products from Argentina for the past five years. (Where tons are given metric tons of 2,204 pounds are understood.)

Exportation of principal products during the last five years.

Animals and animal products.	1898.	1899.	1900.	1901.	1902.
Steers.....number..	359,296	312,150	150,150	119,189	118,56
Wethers.....do....	577,813	543,458	198,102	25,746	122,01
Horses.....do....	14,360	7,259	32,969	9,761	16,0
Mules.....do....	10,205	7,740	13,179	20,468	54,92
Frozen beef.....tons..	5,867	9,079	24,590	44,904	70,0
Frozen mutton.....do....	59,834	56,627	56,412	63,013	80,0
Unwashed sheepskins.....do....	42,245	41,697	37,593	41,120	41,9
Salted cowhides.....do....	29,370	28,528	26,423	28,158	35,3
Dry cowhides.....do....	23,174	23,956	24,866	26,647	26,7
Salted horsehides.....do....	160,180	134,774	121,285	136,901	135,0
Dry horsehides.....do....	180,827	130,057	190,241	181,027	282,1
Wool.....do....	221,280	237,111	101,113	228,358	197,3
Jerked beef (tasajo).....do....	22,242	19,164	16,449	24,296	22,3
Various frozen meats.....do....	971	922	1,089	1,410	2,3
Canned beef.....do....	1,023	1,816	1,405	947	1,6
Tallow.....do....	29,341	24,150	24,897	33,368	49,9
Butter.....pounds..	2,042,562	2,600,317	2,327,506	3,329,338	2,0

EXPORTS IN DETAIL.

The animal exports of the Argentine Republic for the calendar year 1902, in quantity and value, compared with the previous year, ended December 31, 1901, are given herewith. All measurements have been reduced to those of the United States except tons, where the metric measurement has been left unchanged. The valuations are in Argentine gold, the dollar of which is worth 96.5 cents United States money.

Exports of animals and animal products during calendar year 1902 compared with 19

Animals and animal products.	Quantities.		Values.	
	Number or quantity in 1902.	More (+) or less (−) than in 1901.	Value in 1902.	More or less than in 1901.
Asses.....number..	14,223	+ 5,430	$284,460	+ $
Cattle.....do....	118,303	− 886	2,848,445	−
Goats.....do....	2	− 1	10	.....
Horses.....do....	16,008	+ 6,247	460,035	+ 227,
Mules.....do....	54,928	+ 34,460	1,647,840	+ 1,03
Sheep.....do....	122,501	+ 96,755	368,656	+ 290,
Hogs.....do....	532	+ 282	8,250	+ 4,

Exports of animals and animal products during calendar year 1902 compared with 1901—Continued.

Animals and animal products.	Quantities.		Values.	
	Number or quantity in 1902.	More (+) or less (−) than in 1901.	Value in 1902.	More (+) or less (−) than in 1901.
Horns ..... tons..	2,475	+ 671	$197,988	+ $42,660
Frozen beef ..... do....	70,018	+ 25,114	7,001,883	+2,511,386
Frozen mutton ..... do....	80,073	+ 17,060	6,405,804	+1,364,781
Horse hair ..... do....	2,651	+ 88	1,064,646	+ 59,969
Sheepskins ..... do....	41,405	+ 285	8,487,078	+1,147,266
Salted cowhides ..... do....	35,343	+ 7,185	6,384,955	+1,103,199
Dry cowhides ..... do....	26,558	− 89	8,822,302	− 26,136
Wool ..... do....	197,936	− 30,422	45,810,749	+1,144,266
Jerked meat (tasajo) ..... do....	22,304	− 1,992	2,647,450	− 232,005
Various frozen meats ..... do....	2,520	+ 1,110	163,820	+ 72,172
Salted horsehides ..... number..	135,685	− 1,216	406,794	+ 15,968
Dry horsehides ..... do....	282,138	+101,111	460,906	+ 167,501
Goatskins ..... pounds..	3,025,185	+116,050	823,328	+ 31,583
Kid skins ..... do....	1,075,494	− 43,318	292,704	− 11,790
Pickled tongues ..... do....	1,221,093	−274,887	166,164	− 37,409
Salted tongues ..... do....	23,289	− 3,600	1,690	− 262
Pressed tallow ..... do....	113,903	+101,467	3,617	+ 3,222
Canned beef ..... tons..	1,644	+ 697	164,404	+ 69,687
Butter ..... do....	4,125	+ 2,615	1,277,969	+1,100,424
Rendered fat and tallow ..... do....	49,095	+ 15,727	6,209,038	+2,306,323
Sole leather ..... number..	16,633	+ 14,662	83,165	+ 73,215
Tanned cowhides ..... do....	134	− 286	268	− 572
Tanned sheepskins ..... dozen..	140,914	+140,914	563,656	+ 563,656
Other tanned skins	.....	.....	417	− 205,221
Extract of beef ..... pounds..	653,329	+175,382	592,696	+ 159,106
Cheese ..... do....	14,374	+ 11,400	1,304	+ 1,034
Casein ..... do....	207,395	+207,395	21,839	+ 21,839
Animal oil ..... do....	381,859	+ 54,436	20,412	+ 5,182
Concentrated soup ..... do....	86,480	− 32,692	11,769	− 2,448
Bone ash ..... tons..	13,769	+ 9,332	94,865	+ 69,226
Clippings of hides ..... do....	1,803	+ 430	41,637	+ 2,167
Guano ..... do....	1,455	+ 639	36,385	+ 14,374
Bones ..... do....	35,059	+ 7,557	341,732	+ 24,019
Hoofs ..... do....	1,093	+ 344	13,660	+ 4,303
Dried blood ..... do....	925	− 77	46,271	− 3,849
Salted tripe, sausage casings, etc ..... do....	2,189	+ 282	109,457	+ 14,101
Dried tripe, sausage casings, etc ..... pounds..	286,353	+106,751	5,196	+ 1,937
Burned bones ..... do....	.....	− 50,000	.....	− 5,000
Grease scraps ..... do....	2,388,356	−127,082	54,166	− 2,883
Ostrich feathers ..... do....	103,804	− 28,792	86,122	− 35,000
Eggs ..... dozens..	4,798	+ 4,798	480	+ 480
Bristles ..... pounds..	23,713	+ 23,713	430	+ 430
Chicken feathers ..... do....	29,112	+ 6,845	660	− 140

DISTRIBUTION OF EXPORTS.

The following table shows the distribution of the principal Argentine exports in 1902, as reported by the national statistical bureau. Giving only certain countries, the destination of a large part of certain articles is lost sight of. This is noticeable in the shipments of horses,

cattle, and sheep, most of which went to South Africa. Many ships sail from Argentine ports bound for St. Vincent "for orders," and they do not know until they reach that port where they will be ordered to take their cargo. The shipper has the two or three weeks that the ship requires to make the voyage to this point to determine where he will sell the cargo. Hence the Argentine port records never show where these cargoes were sold, but they are all for European or English ports.

Exports of animals and animal products, 1902, and their destination.

Country of import.	Cattle.	Horses.	Sheep.	Horse-hides.	Frozen beef.	Frozen mutton.	Jerked beef (tasajo).	Wool.
	Number.	*Number.*	*Number.*	*Number.*	*Metric tons.*	*Metric tons.*	*Metric tons.*	*Metric tons.*
Belgium	.....	44	.....	700	.....	.....	239	22 342
Brazil	28,923	1,205	3,550	100	.....	3	13,841	5
France	103	191	500	1,000	.....	.....	191	86,007
Germany	.....	59	.....	313,707	.....	.....	12	49,750
Italy	.....	4	.....	19	.....	.....	3	1,905
Spain	1,124	141	1,452	849	.....	.....	68	.....
United Kingdom	.....	383	.....	100	54,402	70,371	451	11,210
United States	.....	.....	.....	47,915	.....	.....	366	12,439
Uruguay	47,884	1,625	335	5,601	.....	.....	2,355	151
Other destinations	39,328	12,352	116,480	47,832	15,616	9,699	4,778	13,687
For orders	941	4	184	.....	.....	.....	.....	453
Total	118,303	16,008	122,501	417,823	70,018	80,073	22,304	197,993

Country of import.	Bones.	Salted cow-hides.	Dry cow-hides.	Sheep-skins.	Kid and goat skins.	Ostrich feathers.	Horse-hair.	Tallow.
	Metric tons.	*Metric tons.*	*Metric tons.*	*Metric tons.*	*Pounds.*	*Pounds.*	*Metric tons.*	*Metric tons.*
Belgium	1,474	5,219	697	1,003	40,683	18,743	643	1,128
Brazil	.....	.....	4	54	.....	441	.....	2,067
France	956	2,127	450	23,829	1,426,050	33,766	51	3,729
Germany	3,388	13,308	1,021	2,299	.....	1,429	167	1,852
Italy	1,426	167	2,523	2,693	3,527	908	429	6,925
Spain	121	316	2,915	16	20,192	8,331	.....	1,961
United Kingdom	3,304	2,850	227	3,962	1,043	.....	88	28,140
United States	14,009	4,086	11,990	20	1,374,436	24,339	424	2,500
Uruguay	983	1,725	2,945	519	3,005	2,498	397	1,800
Other destinations	5,305	4,552	3,786	7,010	1,231,743	13,349	472	2,068
For orders	4,093	963	.....	.....	.....	.....	.....	.....
Total	35,059	35,343	26,558	41,405	4,100,679	103,804	2,651	49,070

U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF ANIMAL INDUSTRY—Bulletin No. 49.

D. E. SALMON, D. V. M., Chief of Bureau.

THE COLD CURING OF CHEESE.

Report upon Experiments Conducted Under the Auspices of the U. S. Department of Agriculture, Bureau of Animal Industry, Dairy Division, in Cooperation with the Wisconsin Agricultural Experiment Station and the New York Agricultural Experiment Station.

BY

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AND

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1903.

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
Washington, D. C., August 1, 1903.

SIR: I have the honor to transmit herewith a manuscript on the cold-curing of cheese, being a report of a cooperative experiment of the Dairy Division and the experiment stations of Wisconsin and New York. The work has been very complete and the results satisfactory in a high degree, and I therefore recommend that this manuscript be published as a bulletin of this Bureau.

Respectfully,

D. E. SALMON,
Chief of Bureau.

Hon. JAMES WILSON,
Secretary.

LETTER OF SUBMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
Washington, D. C., June, 1903.

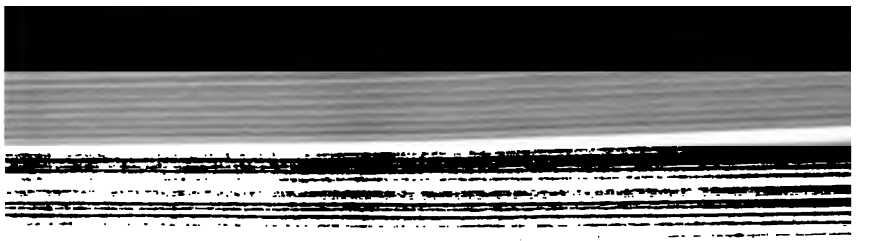
SIR: I have the honor to submit herewith, in manuscript, reports made by officers of the agricultural experiment stations of Wisconsin and New York upon experiments in the cold-curing of cheese recently conducted in cooperation with the Department of Agriculture, and recommend publication of the same as a bulletin of this Bureau.

The work has been under the general supervision of the Dairy Division, and I desire to acknowledge the cordial cooperation of the two experiment stations named and their respective representatives, the material assistance of the cold-storage companies at Waterloo, Wis., and New York City, and the important and efficient services of the cheese experts who acted as scorers or judges, as described in the reports.

Very respectfully, yours,

HENRY E. ALVORD,
Chief of Dairy Division.

Dr. D. E. SALMON,
Chief of Bureau of Animal Industry.



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THE COLD CURING OF CHEESE.

INTRODUCTION.

By HENRY E. ALVORD, C. E.,
Chief of Dairy Division, Bureau of Animal Industry.

The prevalent opinion among cheese dealers has always been that low temperatures, varying from 35° or 40° to 50° F., or thereabouts, resulted in the production of an inferior quality of cheese, in comparison with that from 60° to 70° F. No carefully controlled experiments bearing on this problem have been recorded earlier than those undertaken by Babcock and Russell at the Wisconsin Agricultural Experiment Station, and described in the Fourteenth (1897) Annual Report of that station. The results of those tests showed that cheese placed at refrigerator temperatures (45° to 50° F.),[a] directly from the press, was of superior quality as to flavor and also as to texture, and that such cheese was wholly free from any bitter or other undesirable taints.

In connection with their studies on the influence which galactase and rennet extract exert on the progress of cheese ripening, the same investigators later employed still lower temperatures (25° to 30° F.). Cheeses were kept at these excessively low curing temperatures for a period of eighteen months. The quality of these cheeses, cured as they were below the freezing point throughout their whole history, was exceptionally fine, and emphasized still more than the previous experiments did the fact that the ripening of cheese can go on at much lower temperatures than has heretofore been considered possible.

These results led to an extended series of experiments, in which cheese made on a commercial scale was cured at a range of temperature from below freezing (15° F.) to 60°—a point which common practice has now accepted as the best obtainable temperature that can be secured without the use of artificial refrigeration.

In these experiments (consisting of five series made at intervals throughout a period of two years) 138 cheeses were used, for which 30,000 pounds of milk were required. These experiments were upon a scale which represented commercial conditions, and therefore obvi-

[a] The first public presentation of these experiments was made at the meeting of the Wisconsin Cheesemakers' Association, in February, 1901.

ated the objection which is often urged in commercial practice against the application of results derived simply from laboratory experiments.

The results of these tests may be found detailed in Bulletin No. 94, and the Eighteenth (1901) and the Nineteenth (1902) Annual Reports of the Wisconsin Agricultural Experiment Station.

The Ontario Agricultural College began experiments on the cold curing of cheese in April, 1901. As a result of these tests, the conclusion was drawn that the cheese cured at low temperatures (37.8° F.) was much superior to that cured in ordinary curing rooms (average temperature during season 63.8° F.). Mr. R. M. Ballantyne, a prominent cheese expert, said of this cheese that "they [the merchants] universally expressed surprise at the condition of the cheese that was put into cold storage at the earliest period (that is, directly from the press), as they expected to find the cheese still curdy and probably with a bitter flavor." If this experiment is borne out by other experts, it would appear as if the best way to handle hot-weather cheese would be to ship it to the cold storage directly after making, and this would certainly mean a great revolution to the trade.[a]

More extensive experiments are in progress in Canada, but the results have not yet been published, although general statements have been made confirming previous conclusions.

A considerable number of experiments have also been made at other stations (Dominion government tests and New York State and Iowa experiment stations), where somewhat lower temperatures were used than those which are normally employed for ripening. The results obtained all show an improvement in quality that becomes more marked as the temperature is reduced.

In order that a much larger experiment might be instituted, covering the different types of cheese as represented by Eastern as well as Western manufacture, Drs. Babcock and Russell, of the Wisconsin Station, presented this matter for consideration to the Dairy Division of the Bureau of Animal Industry. As a result of this proposal the officers of the New York Agricultural Experiment Station were also consulted and plans perfected for the cooperative experiments conducted simultaneously in Wisconsin and New York, which are described in full in this bulletin. It should be noted that it was so late in the season of 1902 when the arrangements for this work were completed that it was impossible to obtain favorable conditions in all respects.

It was deemed desirable that the cheese to be tested should represent the product of as wide a range of territory as possible, and therefore it was decided to establish two curing stations—one in the East and the other in the West. Drs. S. M. Babcock and H. L. Russell were put in charge of the Western experiments and Dr. L. L. Van Slyke and Mr. G. A. Smith of those in the East.

[a] Bulletin No. 121, Ontario Agricultural College, June, 1902.

OBJECTS OF THE EXPERIMENTS.

In addition to the influence which a range in temperature exerts on the quality of cheese, as determined by flavor and texture scores, instructions were also issued to secure data regarding the loss in weight which the different lots of cheese suffered at the different temperatures. The commercial quality of the product was to be determined by a jury of experts who were thoroughly in touch with the demands of the market. Although the effect of coating cheese with paraffin soon after being taken from the hoop was not at first proposed as a part of this work, it was finally included, both East and West.

The reasons for selecting 40°, 50°, and 60° F. as the temperatures to be used in these experiments are fully given on a later page. It may be assumed that the advantages of a cool and even temperature in curing Cheddar cheese have been already established in preference to a warm temperature or to very variable conditions which frequently include periods above 70° and sometimes much higher. As already stated, 60° or thereabouts is regarded as the lowest temperature practicable without artificial refrigeration; this may therefore be taken as fairly representative of what may be called a "cool" temperature for curing cheese. And rooms held at 40° and 50° were selected as representative of a "cold" temperature for curing, or comparatively so. It is thus hoped to emphasize by these experiments the distinction between cool curing and cold curing.

The cheese for these experiments was purchased by the United States Department of Agriculture, which also paid all expenses of transportation and storage and for the experts who made the periodical examinations. The two experiment stations selected the cheese, arranged all details of storage and examination, supervised the work throughout, performed the chemical and other incidental scientific work, kept the records, and reported results.

In order that a uniform system of scoring might be followed in the experiments, the appended score card was used for both:

EXPERIMENTS IN CURING CHEESE AT LOW TEMPERATURES, UNITED STATES DEPARTMENT OF AGRICULTURE, BUREAU OF ANIMAL INDUSTRY, DAIRY DIVISION.

Cheese judging—Numerical and descriptive score card.

Score for cheese (or sample) marked.....

NUMERICAL SCORE.

PERFECTION:	Flavor 45 points.	Texture 30 points.	Color 15 points.
SCORE:	do.	do.	do. .....

Date: ....., 190 . Initials of the judge: .....

DESCRIPTIVE SCORE. (Check the faults below.)

Flavor.		Texture and body.		Color.	
Perfect	Clean.....	Perfect	Silky	Perfect.....	
High	Flat or low	Smooth.....	Waxy.....	Straight.....	
Too high acid		Pasty.....	Salvy	Translucent.....	
Needs more acid		Stiff	Weak.....	White specks	
Sour.....	Sweet	Curdy	Mealy	Streaked.....	Wavy.....
Tainted	Weedy.....	Tallowy	Gritty	Mottled.....	Acid cut .....
Barny	Cowy.....	Close	Loose.....	Too high	Too light.....
Old milk		Holes, mechanical		Uncolored	
Poor sewerage, dirty cans		Holes, gas	Holes, Swiss...		
		Watery	Too dry.....		

Each of the following reports, prepared by the two experiment stations participating in this work, treats the same general subject and similar lines of experiment and observation from its own point of view. The reports therefore differ in many respects, and yet they may be easily compared upon all essential points. Both support the following general conclusions:

ADVANTAGES OF CURING CHEESE AT LOW TEMPERATURES BRIEFLY SUMMARIZED.

(1) The loss of moisture is less at low temperatures, and therefore there is more cheese to sell.

(2) The commercial quality of cheese cured at low temperatures is better, and this results in giving the cheese a higher market value.

(3) Cheese can be held a long time at low temperatures without impairment of quality.

(4) By utilizing the combination of paraffining cheese and curing it at low temperatures the greatest economy can be effected.

THE WESTERN EXPERIMENTS, 1902–03.

Conducted by S. M. Babcock and H. L. Russell, assisted by U. S. Baer,
Of the Wisconsin Agricultural Experiment Station.

For the purposes of this experiment Chicago would naturally have been chosen as a curing station, but it was found difficult to make arrangements for the range of temperature desired. Suitable arrangements, however, were made at the cold-storage warehouse of the Roach & Seber Co., Waterloo, Wis., where rooms were fitted up and the desired temperatures secured.

SELECTION OF THE CHEESE.

As Wisconsin is the leading cheese-producing State of the West, the bulk of the product selected for experiment was of the type of cheese manufactured in this State. In order, however, to cover more thoroughly the cheese-producing territory of the West, samples were also secured from a number of the neighboring States. In this way all types of American cheese were obtained, ranging from the firm, typical Cheddar cheese, suitable for export, to the soft, open-bodied, moist cheese, intended for early consumption. For convenience we may group these various lots of cheese under three different types, as follows:

I. Close-bodied, firm, long-keeping type, suitable for export trade (typical Cheddar).

II. Sweet-curd type.

III. Soft, open-bodied, quick-curing type, suitable for early consumption.

Type I represents the class of cheese that is especially manufactured in Wisconsin, while, as a rule, type III represents the kind of cheese that is chiefly made in Michigan. The representatives of the sweet-curd type were taken from Iowa and Illinois, although this class is made to some extent in all sections.

The table herewith gives the location of the factories from which the different lots were secured, also the size and amount of cheese so purchased.

Origin of cheese and quantities used in experiments.

Origin and type.	Style.	Number.	Weight
I.—*Export type.*			
Wisconsin:			*Pounds.*
Thos. Johnston, Boaz, Richland County	Flats	20	662
H. J. Noyes, Muscoda, Grant County	do	18	571
P. H. Kasper, Nicholson, Waupaca County	do	18	569
La Crosse Cheese and Butter Co., Alma, Buffalo County	Daisies	60	1,151
Do	Prints	40	409
II.—*Sweet-curd type.*			
Iowa:			
E. G. Hodges, Union, Hardin County	Flats	20	607
Illinois:			
J. B. Gilbert & Co., Sterling, Whiteside County	do	20	563
III.—*Soft, home-trade type.*			
Michigan:			
A. H. Barber & Co., Merrill, Saginaw County:			
I	Flats	9	287
II	do	9	287
III	do	29	924
IV	do	13	415

In having the cheese made at these various factories directions were given for the use of a uniform amount of rennet and salt. Color was left optional for each maker to follow his customary practice. The use of 3½ ounces of Hansen's rennet extract and 2½ pounds of salt per 1,000 pounds of milk was recommended in each case with the exception of the smaller cheeses (daisies and 10-pound prints), which were salted at the rate of 2¼ pounds per 1,000 pounds of milk. The cheese was made from September 26 to October 4. The condition of the milk was influenced in several instances by the fact that severe frosts had occurred in some sections, which injured the quality of the product. This was particularly true in the case of the Alma cheese, which was in consequence somewhat tainted. The milk from which the Iowa cheese was made was also reported as of inferior quality. The Michigan goods were too high in acid, and were cooked low, making a soft cheese, which was quick-curing and which kept poorly.

Where it was necessary to secure cheese from such a wide range of territory it was manifestly impossible to expect that the curing could be carried out as satisfactorily as if it had been done at or near the factories. The varying period of transit to which the cheese was subjected, with no especial temperature control, affected, of course, the initial stages of curing, but the conditions of the experiment prevented the carrying out of immediate installation of the cheese in the cold curing rooms, especially in the case of those made outside of Wisconsin, although the shipments were made in October, when the temperature range was moderate.

TEMPERATURES AT WHICH THE CHEESE WAS CURED.

The cheese was weighed and put in the respective rooms as soon as received at Waterloo. It was stored in boxes during the curing, as is the custom in the handling of cold-storage goods. The temperatures at which it was desired to hold the cheese for curing were 40°, 50°, and 60° F. These points were selected for the following reasons: In our previous experiments we had found that the character of the cheese cured at the lower temperatures (40° and 50°) was much better than that produced at 60°. Perhaps it would have been better for the purpose of the experiment if the cold-cured cheese could have been compared with the same make of cheese cured under the widely variable conditions which prevail in most factories, where often the maximum temperature is in the neighborhood of 80° F. and the fluctuation is 20° or more; but we have made this comparison with the very best conditions that obtain in factories provided with subearth ducts and other means of temperature control. In such cases a temperature of 60° can be maintained with a fair degree of constancy. The experiments, therefore, compare the cold-curing process with that of the best prevailing conditions.

The temperatures actually maintained varied only slightly from the chosen points, and in the two colder rooms were remarkably uniform. The 60° room was subject to somewhat wider fluctuations, but was much more uniform than is obtained in summer where no artificial refrigeration is practiced. The following table gives the average of all the observations made at regular intervals and the maximum and minimum observed throughout:

Temperature records.

	Cold rooms.		Normal temperature.
	Low.	Medium.	
	° F.	° F.	° F.
Average	36.8	46.9	58.5
Maximum	37.0	47.5	61.0
Minimum	35.0	45.0	57.0

The daily fluctuations were inconsequential, as can be seen by a series of graphs taken from the registering instrument.

DETAILS OF SCORING THE CHEESE.

It would have been advisable to have the cheese examined a considerable number of times by the commercial judges, but it was impossible to carry out this test so frequently. The tests were therefore arranged to come at those periods which would give the judges the

most accurate idea of the character of the cheese held at the different temperatures.

As a jury of commercial experts, representing the different markets, the following gentlemen were selected: C. A. White, of Fond du Lac, resident representative in Wisconsin of a leading dairy produce house of New York; T. B. Millar, of London, Ontario, a cheese expert and large buyer for the export trade, and John Kirkpatrick, a member of a leading produce firm of Chicago.

For the jury trials representative cheeses were taken from storage and shipped by refrigerator service to Chicago, where they were submitted to a thorough examination by the commercial judges. The first of these commercial scorings was made when it was found that the 60° product was ready for market. This test was made on January 6, 1903. Another test was made on March 23, when the cheese was about 7 months old.

It might at first thought seem preferable to have had the cheese sold in the open market and thus secured a strict commercial valuation on the product, but, as everyone knows, a considerable variation in quality may exist without an appreciable difference being made in the market price. Then, too, the inevitable fluctuations in the market price would render comparisons at different periods untrustworthy. To obviate these difficulties the cheese was scored on the basis of a standard price (13 cents). The fact that but few of the cheeses reached this standard should not be interpreted as indicating a poorer quality than the average market product, for the cheese was adjudged by the jury to be superior in quality; but the price was in part determined by the market appearance of the goods, which was somewhat inferior because of the fact that they had been box-cured and had received practically no care in curing, as the curing station was located at a distance from Madison.

The scores of the commercial jury were supplemented by a series of scores made by Mr. Baer which covered the entire history of the cheese from the time it was received until its final disposition. In this study it was possible to follow more closely the course of the ripening.

RESULTS OF EXPERIMENTS.

In presenting the data gathered in these experiments we have placed all of the detailed scores made by both the expert judges and Mr. Baer in an appendix. The following text is prepared from a study of these data, but only summaries are given in the text from which the deductions are made.

In outlining these results the data on shrinkage in weight during the experiment will first be given, followed by the serial scores made by Mr. Baer and the jury records obtained at the tests made when the cheese was three and five months old.

PART I.—SHRINKAGE OF CHEESE IN WEIGHT WHEN CURED AT DIFFERENT TEMPERATURES.

The losses in weight which cheese undergoes in the curing process is a matter of such practical importance that it is advisable when possible to accumulate data relating to it. This is all the more important in this connection because no studies have yet been reported on cold-cured cheese, and it was therefore deemed advisable to keep a record of the losses in weight so that the shrinkage at these lower temperatures might be compared with those which normally obtain at the best temperatures now employed. The average shrinkage under existing curing conditions in the majority of factories results in a loss of 5 to 7 per cent for the first thirty days, with a gradually diminishing rate for larger curing periods. This results in a heavy tax to the producer, and any factor which reduces these losses increases thereby the total receipts from the milk produced.

FACTORS INFLUENCING THE RATE OF LOSS.

There are a number of factors which modify the rate at which a cheese loses its water content during the course of ripening. The following factors are known to exert a more or less marked influence, although it is impossible to arrange them in order of their relative importance, as they are always interdependent: (1) Temperature of curing room; (2) relative humidity of air in curing room; (3) size and form of cheese; (4) moisture content of the cheese; (5) protection to external surface of the cheese.

The influence of temperature is closely connected with the relative humidity of the curing room; but, in addition to the effect which the higher temperatures exert on this factor, it should be observed that water evaporates more rapidly at a high than at a low temperature, even though the relative humidity remains the same. The more potent influence of temperature is, however, the effect which varying degrees of heat exert on the relative humidity of the atmosphere. A fall of 20° F. from ordinary air temperatures practically doubles the relative humidity, provided the point of saturation is not passed. As the average relative humidity of the air is generally over 50 per cent, it therefore follows, in cold-curing rooms supplied with outside air, the temperature of which is from 30° to 40° F. higher in summer than the inside temperatures, that the air of these rooms is practically saturated, thus greatly reducing the loss of moisture from the cheese.

So far as the cheese itself is concerned, the moisture of the room may be materially altered by the way in which the cheese is handled during the curing process. If the cheese is shelf-cured, as is the custom in most factories, the surrounding air more nearly approximates the average relative humidity of the entire room than is the case where

the goods are box-cured. In the latter case the air is more nearly saturated, as is shown by the greater liability to mold and rind-rot.

This point is well shown in a series of observations on the relative humidity of the air in a box containing a cheese placed directly therein from the press.

To show this the following observations were made: Wet and dry bulb thermometers (Hydrodeik) were placed in a Cheddar box with a 30-pound flat. An opening was made in the top and covered with glass so that observations could be made directly without opening the box. The apparatus was placed for a period in rooms at different temperatures and the observations recorded as follows:

Relative humidity of air surrounding box-cured versus shelf-cured cheese.

	Temperature range.	Relative humidity	
		Room.	Cheese box.
	° *F.*	*Per cent.*	*Per cent.*
Room I	35–40	85–92	100
Room II	50–55	55–75	91
Room III	60–69	50–70	84–90

A factor which is frequently overlooked is the varying moisture content of the cheese. The more moisture there is left in the cheese the more rapid the evaporation. The varying moisture content of different types of cheese is determined by the temperature at which the curds are cooked, the time of exposure, and the acidity of the curd. A cheese in which the acidity is developed is materially drier than a sweet-curd cheese. Salt also has a tendency to diminish the water content. In the foregoing cases the cause of this diminution in moisture is due to the shrinking of the curd particles under the influence of these factors. An increase in fat lessens the drying of the curd. Much loss of moisture can also be prevented by coating the cheese with paraffin, a practice which is now coming into very general use for the prevention of mold and to lessen shrinkage in weight.

EXPERIMENTS IN SHRINKAGE OF COLD-CURED CHEESE.

In these experiments the first careful weighings were made when the cheese was received at the cold-storage plant in Waterloo. The cheese was shipped from the factories directly after it was removed from the press, but was in every case several days upon the road. In no instance was the interval between making and installing in cold-curing rooms less than five days, and it ranged from this up to seventeen days with one lot from Michigan, which was delayed in transit. During this period, which was in early October, the cheese was subjected to varying conditions of temperature and exposure. In a few

cases boxes were broken, and in other instances the cheese was delayed at points of transfer. It was impossible to obviate these difficulties, as the cheese was purchased at distant points in order to secure representation from a wide range of territory and from different types of cheese. This variation in initial drying changed, of course, the rate of loss when cheese was placed in cold-curing rooms, so that this factor must be taken into consideration in studying the data presented below.

The losses reported here cover those only which took place in the cheese after it had reached the cold-curing rooms, but careful records have been kept for the entire curing period; and these data, we believe, are of sufficient importance to warrant full consideration in this connection.

DETAILS OF WEIGHING.

The cheese was all weighed on counter scales, weighing accurately to fractions of an ounce. In order to check the accuracy of the weights, each cheese was weighed separately and the weight recorded; then the whole lot was weighed collectively. As these weights agreed within a few ounces, they show the accuracy of the weighings. For practical purposes it is desirable to know the losses which occur for stated periods. It was, however, impracticable for all of the cheese to be weighed at exactly the same intervals, as it was put in storage at different dates, but it was designed to secure at least three weighings for the first month of storage, two weighings for the second, and at about monthly intervals thereafter. If these data are charted, it is possible to deduce an estimated loss for any stated period, and in doing so we have selected the following intervals as being those concerning which data would be most frequently desired. For this purpose ten, twenty, thirty, sixty, ninety, etc., days have been selected.

CONDITIONS UNDER WHICH THE CHEESE WAS STORED.

In this work the attempt was made to hold the cheese at 40°, 50°, and 60° F. The actual temperatures secured averaged 36.8°, 46.9°, and 58.5° F. The variation in temperature in the two lower rooms was practically negligible, as it was only 2° to 2½°. The temperature of the 60° room oscillated somewhat more (4° F.), but was very much more uniform than ordinary factory curing rooms. (See figs. 1, 2, and 3 for samples of the thermometric record.)

Hygrometric data were not secured during the whole period, as it was at first thought that a saturated atmosphere would prevail where the cheese was box cured, but during the course of the experiments it was noted that the 50° cheese was not molding as much as was that at 40° and 60°. This fact could only be explained by the assumption that a less humid atmosphere was present in the case of the 50° room.

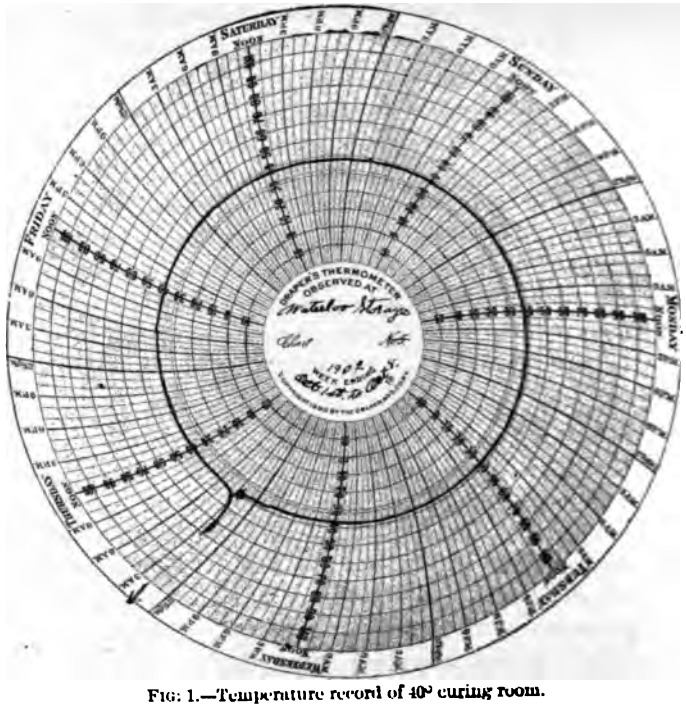


FIG. 1.—Temperature record of 40° curing room.

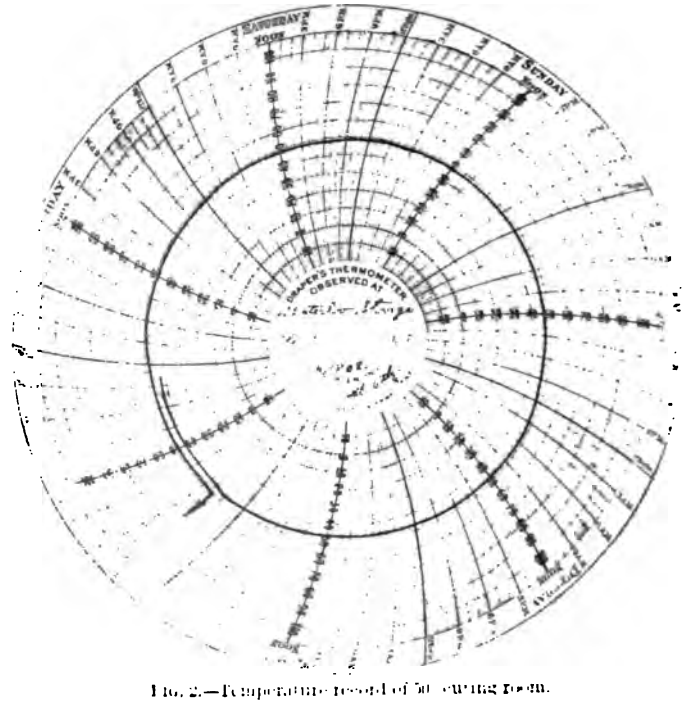


FIG. 2.—Temperature record of 50° curing room.

Observations at the end of the experiment showed a relative humidity in the different curing rooms as follows:

	Temperature.	Relative humidity.
	° *F.*	*Per cent.*
Room I..	37	92
Room II.	48	73
Room III	59	72

It will be observed in the figures later presented that the difference in rate of loss at 50° and 60° was higher toward the end of the experiment than in the earlier stages. This probably means that

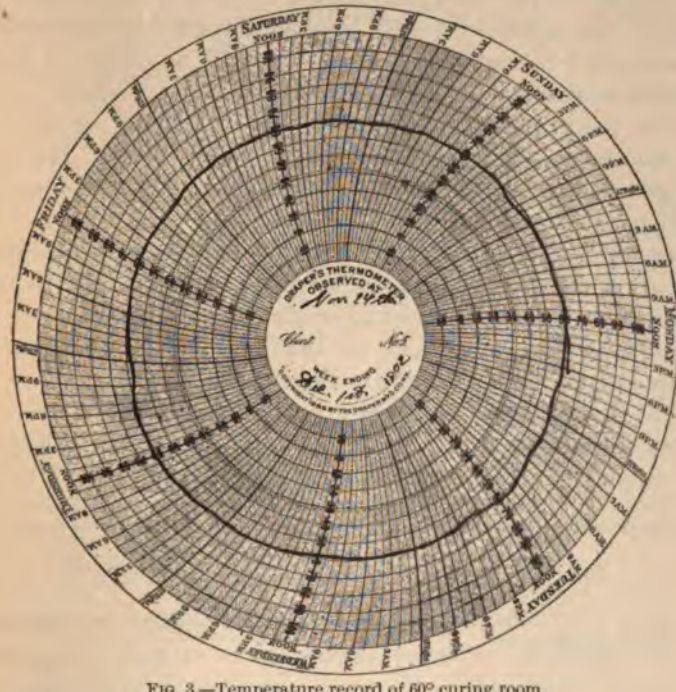


FIG. 3.—Temperature record of 60° curing room.

the relative humidity of room III was diminished at this time, bringing it down from a moister state to approximately the same humidity as the 50° room. If this was so, this would account for the lessened development of mold at 50°, as mold is very sensitive to hygrometric conditions.

DISCUSSION OF RESULTS.

As there are several factors which affect the rate of shrinkage which the cheese suffers in curing, it will be desirable to discuss the data collected under several heads. The conditions of the experiment

were such as to temperature that an especially favorable opportunity was had for the study of the influence which this factor exerts on the cheese. It is, of course, necessary in a study of this sort to have the cheeses uniform in size. The moisture contents of the cheese can not, of course, be made alike, but in this study the cheeses of the same type have been grouped together—that is, as firm Cheddars suitable for export and softer, moister cheese intended for home trade.

A. INFLUENCE OF TEMPERATURE ON SHRINKAGE.

To study the rate of loss of Cheddar cheese when kept at different temperatures, 129 flats were selected from nine different lots of cheese made by six different makers. These were exposed at three different temperatures, which averaged, respectively, 36.8°, 46.9°, and 58.5° F. In each of the tables herewith is given the number of cheeses which were subjected to stated weighings. It will be observed that much more data were collected on the lower temperatures than on the 60° lot. This was regarded necessary, as up to this time we have no published data on cheese cured at so low a temperature. The following tables give the actual loss in ounces of each lot of cheese, together with the percentage loss for each period observed.

In arranging these tables the lots of cheese that were similar in type are placed together. This fact gives much more weight to these figures than to those secured on the smaller lots.

For purposes of convenience the different lots of cheese are divided into three types, depending upon their character:

I. Firm-bodied cheese (export type), of Wisconsin.

II. Sweet-curd type, as represented by the Iowa and Illinois makes.

III. A very moist, soft type, suitable for home trade (Michigan).

Shrinkage of firm, typical Cheddar cheese (type I) cured at different temperatures.

LOT 1.—THOS. JOHNSTON, BOAZ, RICHLAND COUNTY, WIS.

Curing period (days).	Loss in weight at different periods of storage					
	At 40° F.		At 50° F.		At 60° F.	
	Ounces.	*Per cent.*	*Ounces.*	*Per cent.*	*Ounces.*	*Per*
10					17	1.2
17			31	1.16	28	1.9
21	17	0.365				
26			50	1.88		
51	37	.796	68	2.55	44	3.
88	51	1.09	92	3.45	58	4.
112	54	1.16	100	3.76	65	4.5
160	58	1.18	123	4.55	81	5.7
Weights of cheeses when received	299 lbs. 6 ozs.		166 lbs. 4 ozs.		97 lbs. 1	
Number of cheeses weighed	9		5			

Shrinkage of firm, typical Cheddar cheese (type I), etc.—Continued.

LOT 2.—H. J. NOYES, MUSCODA, GRANT COUNTY, WIS.

Curing period (days).	Loss in weight at different periods of storage.					
	At 40° F.		At 58° F.		At 60° F.	
	Ounces.	*Per cent.*	*Ounces.*	*Per cent.*	*Ounces.*	*Per cent.*
10	.....	.....	.....	.....	14	0.912
16	.....	.....	16	1.07	26	1.69
19	17	0.374	.....	.....	.....	.....
21	.....	.....	28	1.87	.....	.....
50	35	.77	39	2.61	41	2.67
86	44	.994	63	4.22	49	3.13
110	44	.994	71	4.75	56	3.65
158	50	1.12	82	5.49	78	5.09
Weights of cheeses when received	279 lbs. 12 ozs.		93 lbs. 5 ozs.		95 lbs. 14 ozs.	
Number of cheeses weighed	9		3		3	

LOT 3.—P. H. KASPER, NICHOLSON, WAUPACA COUNTY, WIS.

	Ounces.	*Per cent.*	*Ounces.*	*Per cent.*	*Ounces.*	*Per cent.*
10	18	0.383	13	0.845	11	0.716
20	.....	.....	25	1.62	22	1.43
26	34	.724	.....	.....	.....	.....
37	.....	.....	34	2.21	.....	.....
41	.....	.....	.....	.....	38	2.47
74	40	.852	50	3.25	.....	.....
87	.....	.....	.....	.....	56	3.64
97	45	.951	52	3.38	.....	.....
100	.....	.....	.....	.....	60	3.90
145	.....	.....	68	4.42	78	5.07
163	70	1.46	78	5.06	84	5.46
Weights of cheeses when received	293 lbs. 8 ozs.		96 lbs. 2 ozs.		96 lbs. 1 oz.	
Number of cheeses weighed	9		3		3	

As these three makes of cheese agree quite closely in type, a composite diagram made from the data collected will indicate more nearly the average results which may be expected than where they are considered separately. The actual losses observed in the three foregoing lots of Wisconsin cheese were first charted individually and from these an average curve constructed, which is represented in figure 4. In this and following figures the losses are shown for a period of ninety days only, so that the figures would be on the same scale.

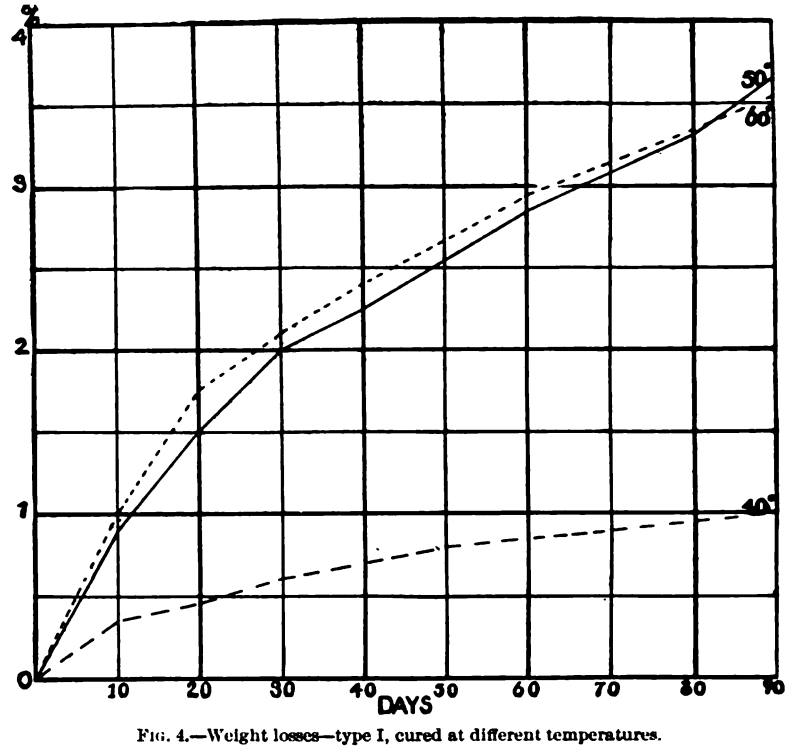


FIG. 4.—Weight losses—type I, cured at different temperatures.

Shrinkage of sweet-curd cheese (type II) cured at different temperatures.

LOT 1.—E. J. HODGES, UNION, IOWA.

Curing period (days).	Loss in weight at different periods of storage					
	At 40° F.		At 50° F.		At 60° F.	
	Ounces.	*Per cent.*	*Ounces.*	*Per cent.*	*Ounces.*	*Per cent.*
7	35	0.774	23	0.933	12	0.8[illegible]
17					22	1.5[illegible]
20			35	1.42		
31	51	1.13			32	2.27
37			63	2.55		
71	55	1.21			61	4.[illegible]
74			76	3.07		
94	69	1.59	86	3.47	66	4.[illegible]
115			103	4.16	78	5.[illegible]
163	85	1.88				
Weight of cheeses when received	282 lbs. 7 ozs.		154 lbs. 7 ozs.		88 lbs. 1[illegible]	
Number of cheeses weighed	9		5		[illegible]	

Shrinkage of sweet-curd cheese (type II) cured at different temperatures—Continued.

LOT 2.—J. B. GILBERT & CO., STERLING, ILL.

Curing period (days).	Loss in weight at different periods of storage.					
	At 40° F.		At 50° F.		At 60° F.	
	Ounces.	*Per cent.*	*Ounces.*	*Per cent.*	*Ounces.*	*Per cent.*
10	22	0.533	26	1.11	15	1.08
20	.....	.....	42	1.80	26	1.88
26	34	.821	.....	.....	.....	.....
37	.....	.....	58	2.41	40	2.89
74	50	1.21	83	3.56	56	4.13
97	62	1.50	92	3.94	.....	.....
100	.....	.....	.....	.....	63	4.56
145	.....	.....	110	4.71	73	5.29
163	74	1.79	.....	.....	.....	.....
Weight of cheeses when received	258 lbs.		145 lbs. 13 ozs.		86 lbs. 4 ozs.	
Number of cheeses weighed	9		5		3	

A composite curve of this type of cheese was made in a similar manner to that noted in type I (fig. 4), and is represented in figure 5.

Shrinkage of soft, moist, home-trade cheese (type III) cured at different temperatures.

LOT 1.—A. H. BARBER & CO., MERRILL, MICH.

Curing period (days).	Loss in weight at different periods of storage.					
	At 40° F.		At 50° F.		At 60° F.	
	Ounces.	*Per cent.*	*Ounces.*	*Per cent.*	*Ounces.*	*Per cent.*
10	6	0.30	6	1.15	5	1.05
20	.....	.....	10	1.92	7	1.47
26	10	.50	.....	.....	.....	.....
37	.....	.....	12	2.30	.....	.....
41	.....	.....	.....	.....	10	2.10
74	14	.70	16	3.07	15	3.15
100	20	1.00	18	3.46	19	3.99
145	.....	.....	21	4.38	28	5.88
Weight of cheeses when received	125 lbs. 6 ozs.		32 lbs. 8 ozs.		29 lbs. 12 ozs.	
Number of cheeses weighed	4		1		1	

Shrinkage of soft, moist, home-trade cheese (type III), etc.—Continued.

LOT 2.—A. H. BARBER & CO., MERRILL, MICH.

Curing period (days).	Loss in weight at different periods of storage.					
	At 40° F.		At 50° F.		At 60° F.	
	Ounces.	*Per cent.*	*Ounces.*	*Per cent.*	*Ounces.*	*Per cent.*
4	2	0.10				
10			4	0.837	4	0.849
20			8	1.67	7	1.47
26	13	.65				
37			11	2.30		
41					10	2.10
74	17	.85	14	2.92	16	3.35
100	28	1.40	18	3.76	20	4.20
145			21	4.38	30	6.30
Weight of cheeses when received	121 lbs. 11 ozs.		29 lbs. 14 ozs.		29 lbs. 12 ozs.	
Number of cheeses weighed	4		1		1	

LOT 3.—A. H. BARBER & CO., MERRILL, MICH.

	Ounces.	*Per cent.*	*Ounces.*	*Per cent.*	*Ounces.*	*Per cent.*
10	42	0.538	32	0.88	17	0.814
20			76	2.08	28	1.34
37	73	.935	102	2.79	44	2.10
74	82	1.05	124	3.39	68	3.25
100	95	1.21	133	3.67	73	3.49
Weight of cheeses when received	487 lbs. 14 ozs.		228 lbs.		13 lbs. 7 ozs.	
Number of cheeses weighed	15		7		4	

LOT 4.—A. H. BARBER & CO., MERRILL, MICH.

	Ounces.	*Per cent.*	*Ounces.*	*Per cent.*	*Ounces.*	*Per cent.*
7	23	0.676	9	0.928	6	1.34
17					11	2.28
20			17	1.75		
34	39	1.14	23	2.37	18	3.73
71	47	1.37	28	2.88	29	6.02
97	55	1.62	38	3.92	32	6.64
145					39	8.09
Weight of cheeses when received	219 lbs. 7 ozs.		60 lbs. 9 ozs.		30 lbs. 9 ozs.	
Number of cheeses weighed	7		2		1	

In the four preceding lots of cheese considerable difference in rate of loss will be noticed. This is explained, when it is considered that these lots were exposed during transit period to higher temperatures

for varying periods of time, as follows: Lot 1, seventeen days; lot 2, fourteen; lot 3, twelve; and lot 4, seven days.

Figure 6 shows a composite curve of the Michigan cheese, which was made in a similar manner to those shown in figures 4 and 5.

GENERAL SUMMARY OF LOSSES AT DIFFERENT TEMPERATURES.

In figures 4, 5, and 6 the average curves showing losses of the different types of Cheddar cheese are shown. Frequently the cheese

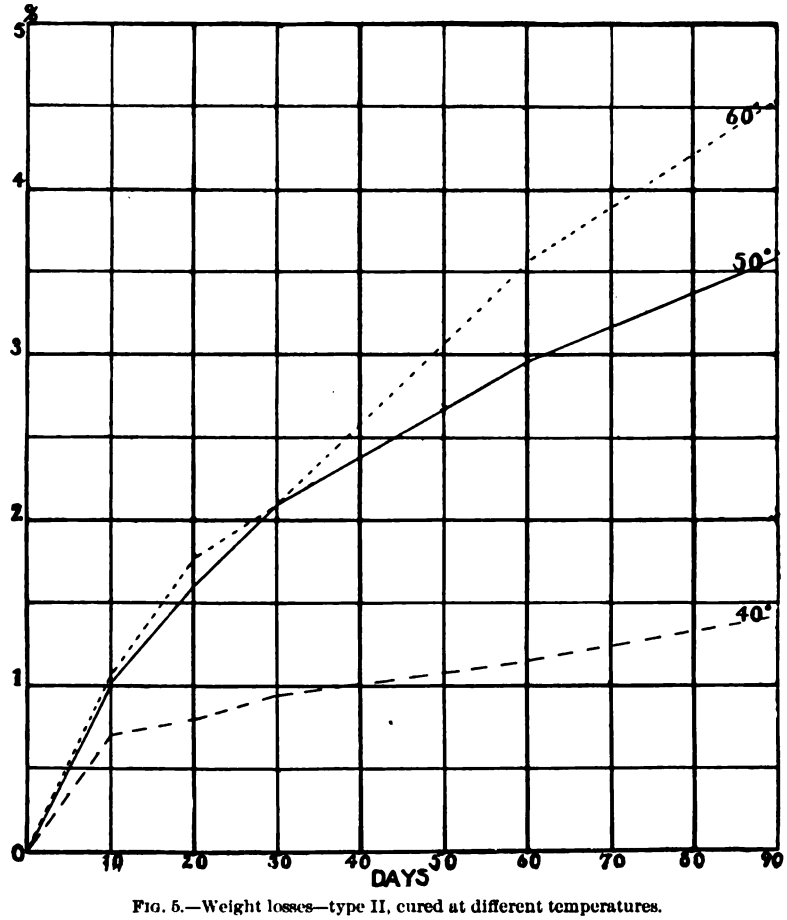


FIG. 5.—Weight losses—type II, cured at different temperatures.

maker wishes to know what these losses would be for stated intervals at different temperatures. With the data at our command it is impossible to answer definitely this question, because of the varying conditions which surrounded the cheese during the transit period, but in the table below the losses which occurred after the cheeses were installed in the respective curing rooms are presented for consideration. In this table the average losses for ten days or multiples thereof

are given. In constructing this table the data for each lot of cheese were first charted. From the curves so obtained the losses of each lot for the periods of ten, twenty, thirty, sixty, and ninety days were

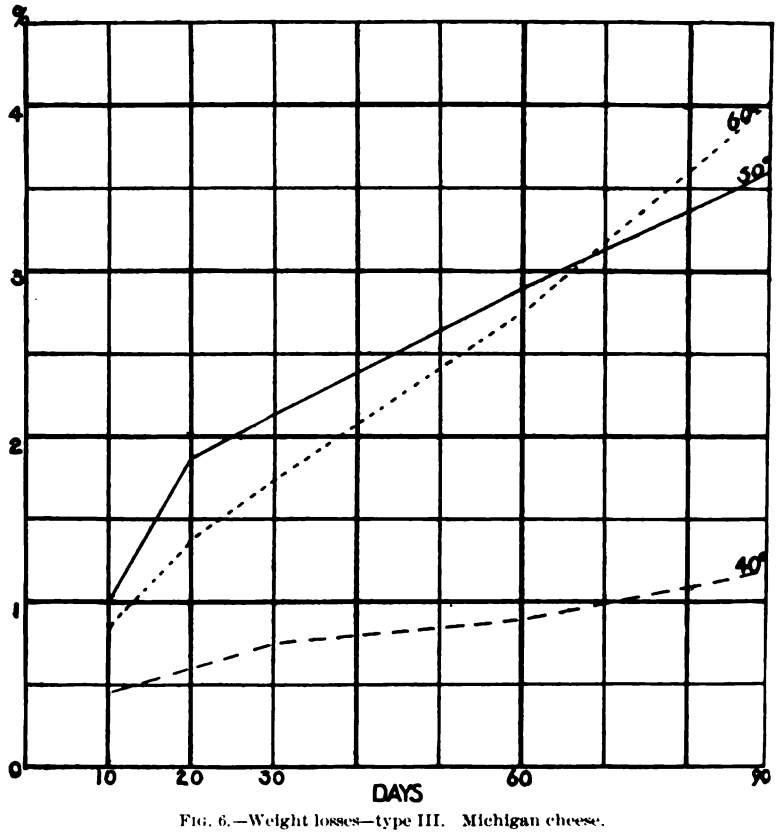


FIG. 6.—Weight losses—type III. Michigan cheese.

taken from the above charts by observation. An average of these losses for each type of cheese is given in the following table:

Losses at different periods in cheese cured at different temperatures.

Days.	Type I (typical Cheddar).			Type II (sweet-curd).			Type III (soft).		
	27 cheeses tested at 40°.	11 cheeses tested at 50°.	9 cheeses tested at 60°.	9 cheeses tested at 40°.	5 cheeses tested at 50°.	5 cheeses tested at 60°.	30 cheeses tested at 40°.	11 cheeses tested at 50°.	7 cheeses tested at 60°.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
10.....	0.38	0.92	0.96	0.69	1.02	1.05	0.49	0.92	0.8[illegible]
20.....	.44	1.48	1.74	.82	1.60	1.77	.64	1.89	1.7[illegible]
30.....	.58	2.00	2.05	.96	2.10	2.29	.84	2.35	1.7[illegible]
60.....	.83	2.87	2.95	1.15	2.97	3.67	.98	2.98	2.[illegible]
90.....	1.00	3.64	3.57	1.42	3.60	4.47	1.21	3.55	4.0[illegible]

As the number of cheeses of the different types cured at the various temperatures were not the same, the percentage losses given in the above table for the varying periods noted are therefore not entitled to equal weight. The smallest number of cheeses were those exposed at

°, while nearly 60 per cent of the entire lot were kept at 40°. This ves much greater weight to the figures presented in the 40° series. In the table it will be observed that there are some apparent dis- epancies, especially in the case of the 50° and 60° lots of type III. iese discrepancies are undoubtedly explained by the fact that this pe of cheese, which was the moistest of the whole lot in the begin- ng, lost more during the longer transit period, and hence the evapo- tion was less than in other types after being placed in cold storage.

(1) The losses sustained by the different lots were very much less at ° F. than at either of the other two temperatures. For a ninety- y period the losses of the 40° cheese ranged from 1 to 1.4 per cent, ıile the 50° and 60° product shrunk from 3.4 to 4.5 per cent for the me time. In other words, by the use of the lower temperature for ring practically two-thirds of the losses which occurred at the tem- ratures of 50° and 60° were prevented. If these results are com- red with what happens under ordinary factory conditions, the loss these low temperatures for a period of ninety days (the minimum ring period recommended) will not be more than one-fourth of that ıich obtains under average factory conditions when the cheeses are ld for a period of about twenty days. The saving for any such fac- ry making 500 pounds of cheese daily would amount to at least 15 ınds of cheese (or $1.50) per day as an average for the season, and nsiderably more than this for cheese made during hot weather. ıis saving in itself would go far toward meeting the extra expense lower temperature curing, even if the product was no better than at cured at higher temperatures.

(2) The differences between the cheese cured at 50° and 60° are not marked as between 50° and 40°. It is quite probable, as before entioned, that the 50° room was somewhat drier than the 60° (as own by the lessened mold growth), and hence the rate of loss was normally increased in this room. This would tend to bring the two rves nearer together.

(3) If the firm Wisconsin type is compared with the softer variety, shown in types II and III, it appears that the losses are consider- ly less, especially at the higher temperatures, although this differ- ce is not so observable at 40°.

(4) The above data presented show a marked saving in losses where e cheese was cold cured, but in these experiments it must be remem- red that the cheese was subjected to higher temperatures during ansit, and hence dried out somewhat more than would have occurred put in storage as soon as removed from the press; also, that this eese was box-cured, and therefore under conditions which prevented pid evaporation. Under other conditions the losses would have en greater than represented here, and the difference in the rate of ss between the different lots wider than reported above. This would ill further increase the saving.

B. INFLUENCE OF SIZE AND FORM OF CHEESE ON SHRINKAGE.

In order to study the influence of size of package on shrinkage during curing, lots of two different sizes were purchased from the same source. These two sizes were the customary daisy type, 13 inches in diameter and 3½ inches high, weighing about 20 pounds apiece, and the newer type of print cheese, put up in 10-pound blocks (10 by 10 by 2⅝ inches). These cheeses were of the usual Wisconsin Cheddar type, although a little firmer than the Wisconsin flats used in these experiments. On account of this difference in type, it is impossible to compare these cheeses directly with the larger 30-pound size.

In the following tables are presented the actual and percentage losses which were noted in the two lots of cheese (daisies and prints) which were purchased from the La Crosse Cheese and Butter Company, of La Crosse, Wis.:

Shrinkage of different-sized cheeses cured at different temperatures.

LOT 1.—PRINTS (10 POUNDS).

Curing period (days).	Loss in weight at different periods of storage.					
	At 40° F.		At 50° F.		At 60° F.	
	Ounces.	*Per cent.*	*Ounces.*	*Per cent.*	*Ounces.*	*Per cent.*
7	.....	.....	1	0.62	2	1.23
10	3	0.371	.....	.....	.....	.....
16	.....	.....	3	1.82	.....	.....
24	.....	.....	.....	.....	4	2.46
41	7	.865	5	3.1	8	4.92
78	11	1.35	9	5.59	14	8.64
100	14	1.73	10	6.2	16	9.88
167	21	2.61	12	7.45	18	11.11
Weights of cheeses when received	50 lbs. 8 ozs.		10 lbs. 1 oz.		10 lbs. 2 ozs.	
Number of cheeses weighed	5		1		1	

LOT 2.—DAISIES (20 POUNDS).

	Ounces.	*Per cent.*	*Ounces.*	*Per cent.*	*Ounces.*	*Per cent.*
7	.....	.....	35	0.673	25	1.14
16	38	0.527	72	1.38	.....	.....
24	.....	.....	.....	.....	41	1.86
30	66	.916	.....	.....	.....	.....
41	.....	.....	103	1.98	65	3.11
78	90	1.25	128	2.46	89	4.26
100	101	1.40	134	2.58	97	4.64
149	136	1.89	148	2.85	118	5.65
Weights of cheeses when received	449 lbs. 15 ozs.		325 lbs. 8 ozs.		130 lbs. 9 ozs.	
Number of cheeses weighed	24		17		7	

In figures 7 and 8 are represented, graphically, the losses observed in the smaller sizes of cheeses (10 and 20 pound varieties). It will be noted that these losses at the different temperatures are greater as the temperature increases, and that the differences between the various temperatures are more marked as the relative size of the cheese diminishes.

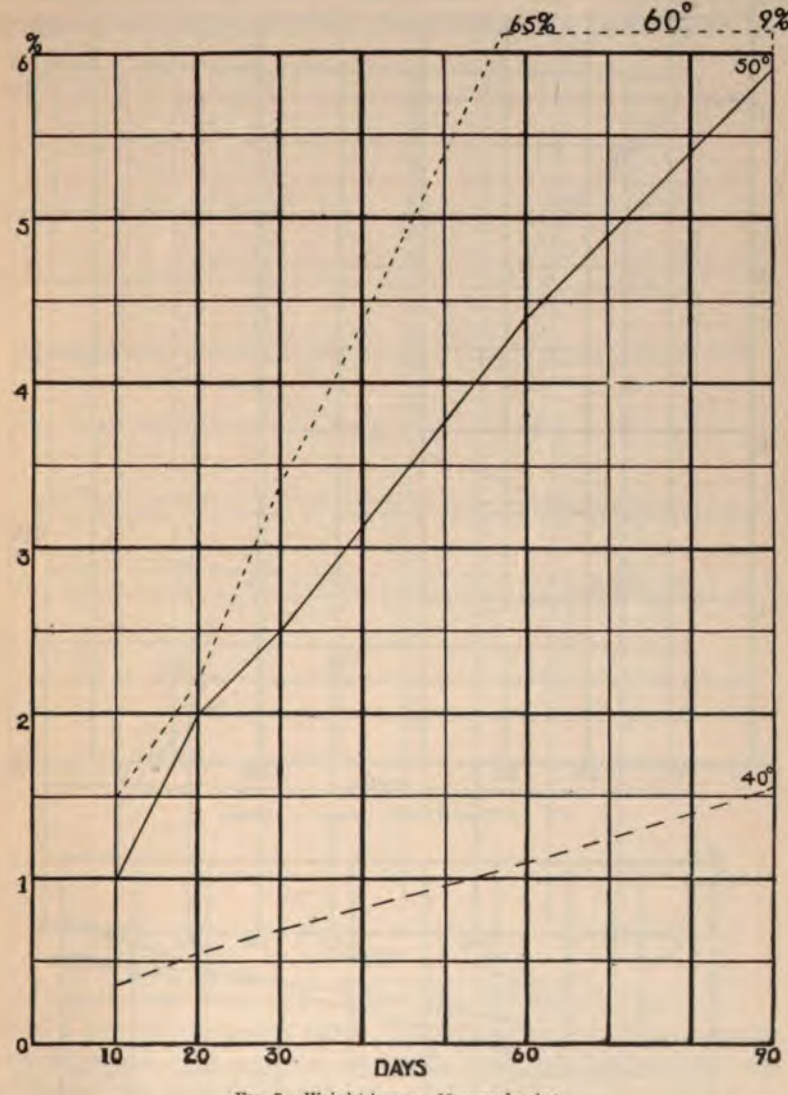


FIG. 7.—Weight losses. 10-pound prints.

In order that a comparison may be made between different sizes of cheeses at the same temperatures, and the losses at these respective temperatures compared with each other, the foregoing data are rearranged in figures 9, 10, and 11, so as to show the rate of losses of the different sizes of cheeses at the different temperatures.

From these curves it is evident that at 40° (fig. 9) the loss was practically the same in both sizes of the cheeses. This is probably because the relative humidity at this temperature was practically 100 per cent, and therefore in a saturated atmosphere the rate of evaporation would be reduced to a minimum, regardless of the size of the cheese.

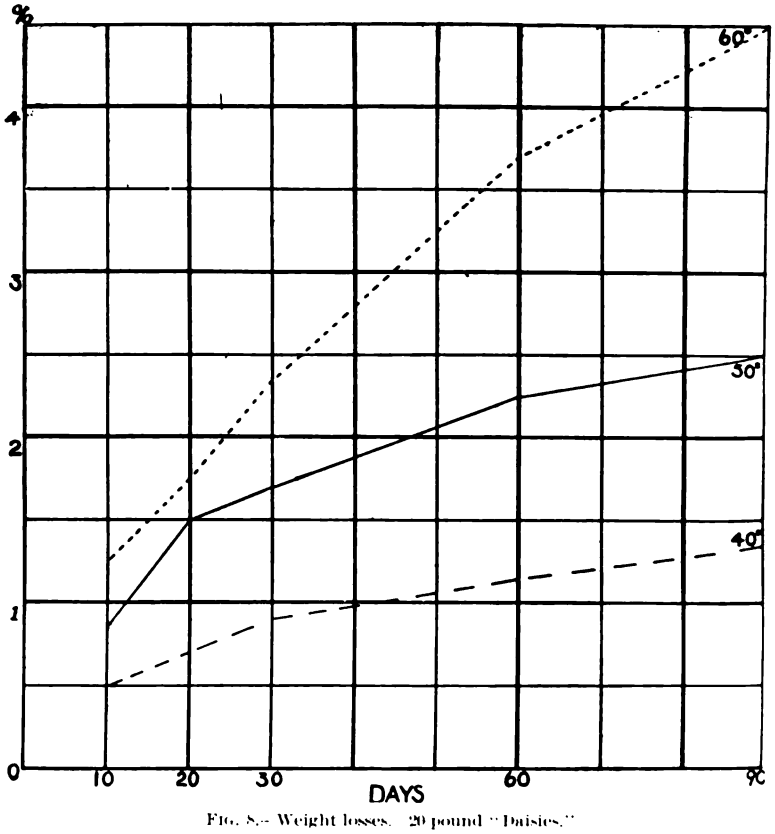


FIG. 8.—Weight losses. 20 pound "Daisies."

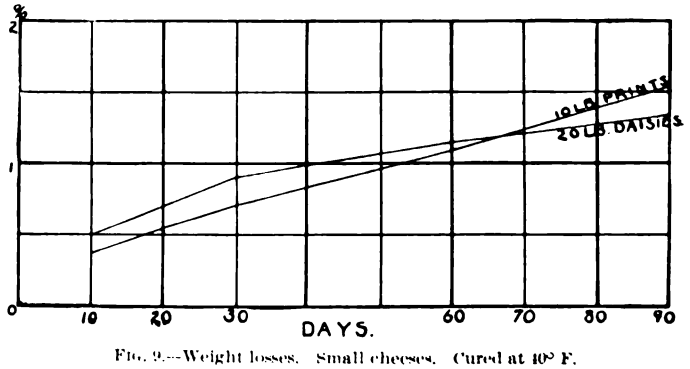


FIG. 9.—Weight losses. Small cheeses. Cured at 40° F.

It must be remembered that the entire loss in weight during the curing of cheese is not due to evaporation. A cheese in curing is

constantly breathing out carbon dioxide the same as any living organism, due to the development of microorganisms (bacterial growth within the cheese as well as molds on surface). Aside from these biological factors, it has recently been shown by Van Slyke and Hart[a] that profound proteolytic decompositions also give rise to an appreciable amount of CO_2. With cheese at 60° F., in which external mold growth was suppressed, they found a loss of approximately one-

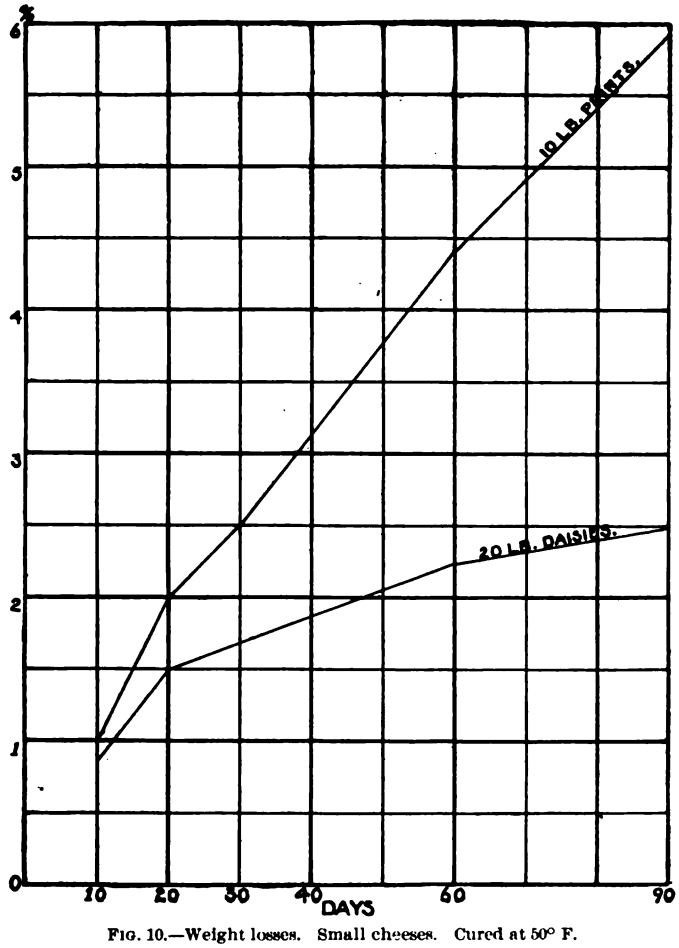


FIG. 10.—Weight losses. Small cheeses. Cured at 50° F.

fourth of 1 per cent in ninety days. In our cold-cured cheese, copious mold development occurred, and hence the losses of carbon from the cheese due to this growth would be considerably greater than if no such growth occurred. With the nearly uniform rate of shrinkage shown in these cold-cured cheeses, regardless of size, it is quite problematical whether this loss in weight may not be chiefly due to the operation of the foregoing factors. If this is so, we may consider

[a] Bul. No. 231, New York Agricultural Experiment Station, p. 38.

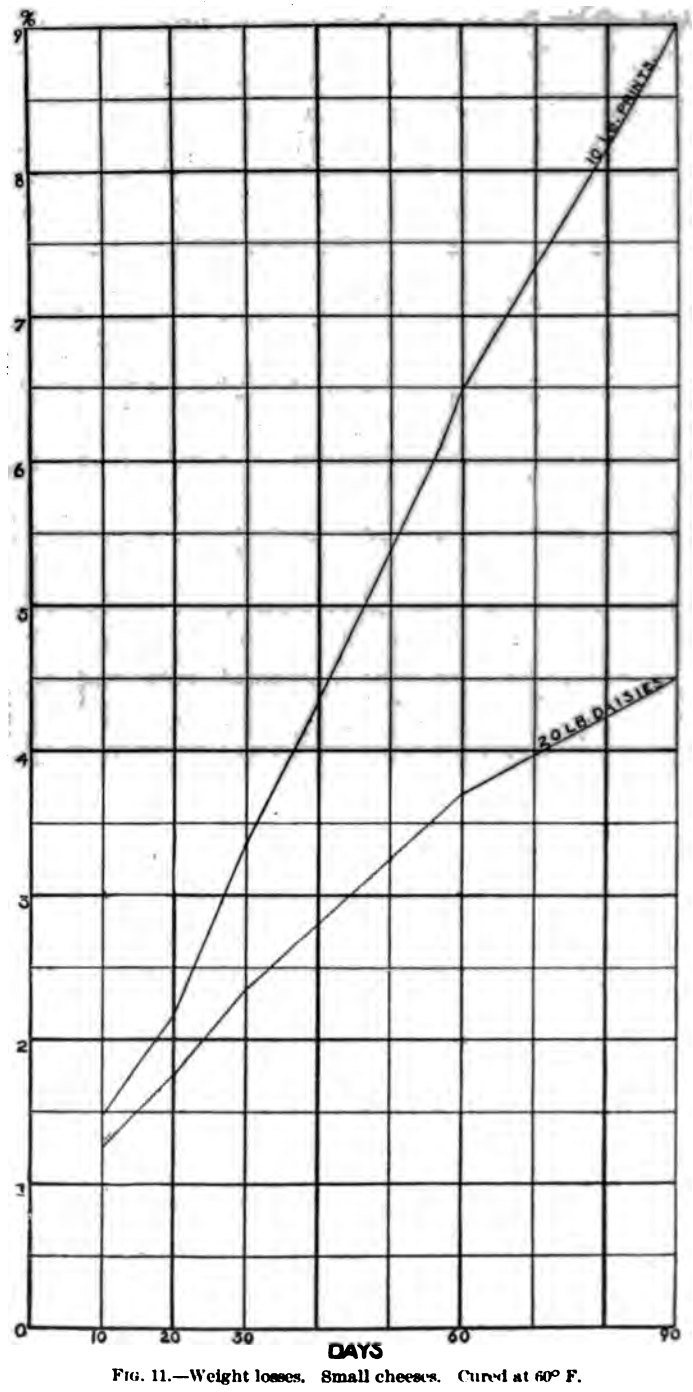


FIG. 11.—Weight losses. Small cheeses. Cured at 60° F.

NOTE.—Figures 9, 10, and 11 should be compared as showing the relative loss of cheeses of different sizes.

such losses as absolutely unavoidable under normal conditions, for the action of microorganisms which can not be suppressed will inevitably result in the production of some volatile products.

At the temperatures of 50° and 60°, where the relative humidity was below saturation, the factor of evaporation is apparent and is inversely related to the size of the cheese. From a practical point of view, it is worth noting that the losses in both sizes of cheeses cured at 60° are approximately 50 per cent more than they are in the cheese ripened at 50° F. (See Figs. 10 and 11.)

C. INFLUENCE OF PARAFFINING CHEESE ON SHRINKAGE DURING CURING.

Within the last few years the custom of coating the cheese with an impervious layer has been suggested, with the object mainly of preventing the development of mold. For this purpose paraffin has been found to be the most suitable agent. The application of such a layer to the cheese not only prevents the growth of mold spores by excluding the air, but materially retards the rate at which the cheese loses its moisture. Paraffined cheese then dries out much more slowly than the untreated product, and the application of this method is of particular service in the handling of the smaller types of cheeses, which have a relatively larger superficial area exposed to the air.

To study the effect of this method of treatment at different temperatures, a number of the smaller sizes of cheeses (daisies and 10-pound prints) were taken from the same make and part of them covered with paraffin. These were divided into three lots and placed in the different curing rooms, where they were held for a period of several months.

In the following table are recorded the data as to the percentage loss in both the paraffined and unparaffined (control) lots:

Shrinkage in paraffined and unparaffined cheese cured at different temperatures.

10-POUND PRINT CHEESE.

Curing period (days).	Loss in weight for different periods of storage.					
	At 40° F.		At 50° F.		At 60° F.	
	Unparaffined.	Paraffined.	Unparaffined.	Paraffined.	Unparaffined.	Paraffined.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
7	.....	.....	0.62	0.24	1.23	0.603
10	0.37	0.495	.....	.....	.....	.....
16	.....	.....	1.82	.84	.....	.....
24	.....	.....	.....	.....	2.46	1.8
41	.865	1.06	3.1	1.45	4.92	2.77
77	1.35	1.48	5.6	2.9	8.64	3.01
100	1.73	1.88	6.2	3.5	9.88	3.62
Number of cheeses tested	5	17	1	5	1	5

Shrinkage in paraffined and unparaffined cheese cured at different temperatures—Cont'd.

20-POUND DAISIES.

Curing period (days).	Loss in weight for different periods of storage.					
	At 40° F.		At 50° F.		At 60° F.	
	Unparaffined.	Paraffined.	Unparaffined.	Paraffined.	Unparaffined.	Paraffined.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
7			0.673		1.14	0.317
14	0.527	0.466				
16			1.38	0.609		
24					1.96	1.76
30	.916	1.10				
41			1.98	.914	3.11	2.54
77	1.25	1.71	2.46	1.65	4.26	3.17
100	1.40		2.58	2.0	4.64	3.49
Number of cheeses tested	24	4	17	1	7	1

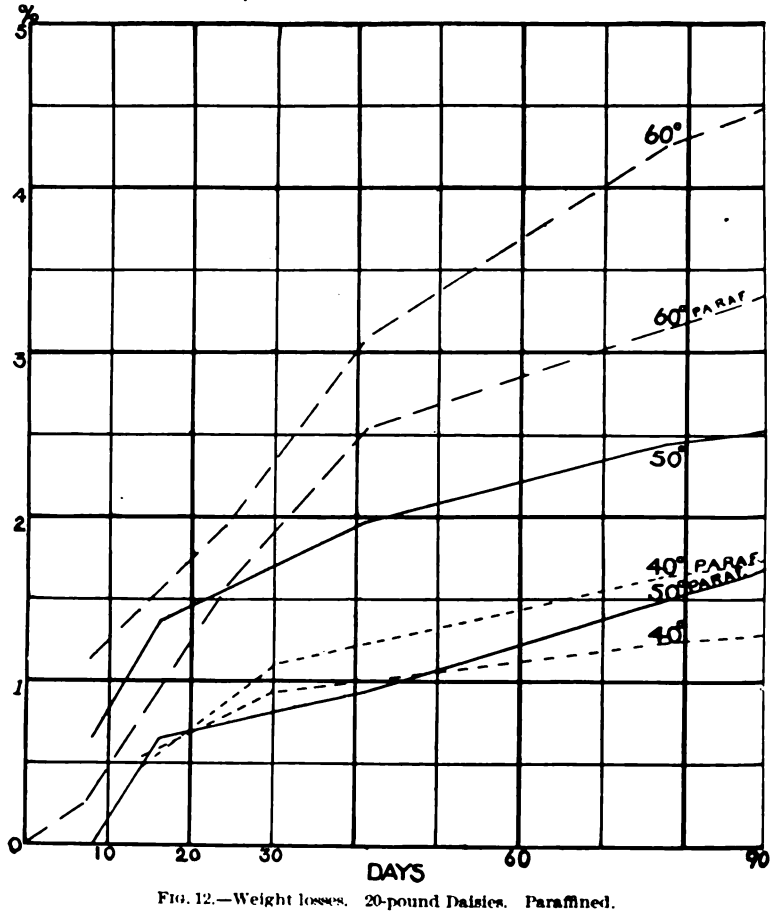


FIG. 12.—Weight losses. 20-pound Daisies. Paraffined.

In order to permit a more ready comparison of the above data, the same are presented in graphical form in figures 12 and 13. At 60° F. he application of paraffin resulted in reducing the losses to less than one-half of that which occurred in the unparaffined lot. This difference s naturally more observable in the smaller-sized cheeses (prints). At

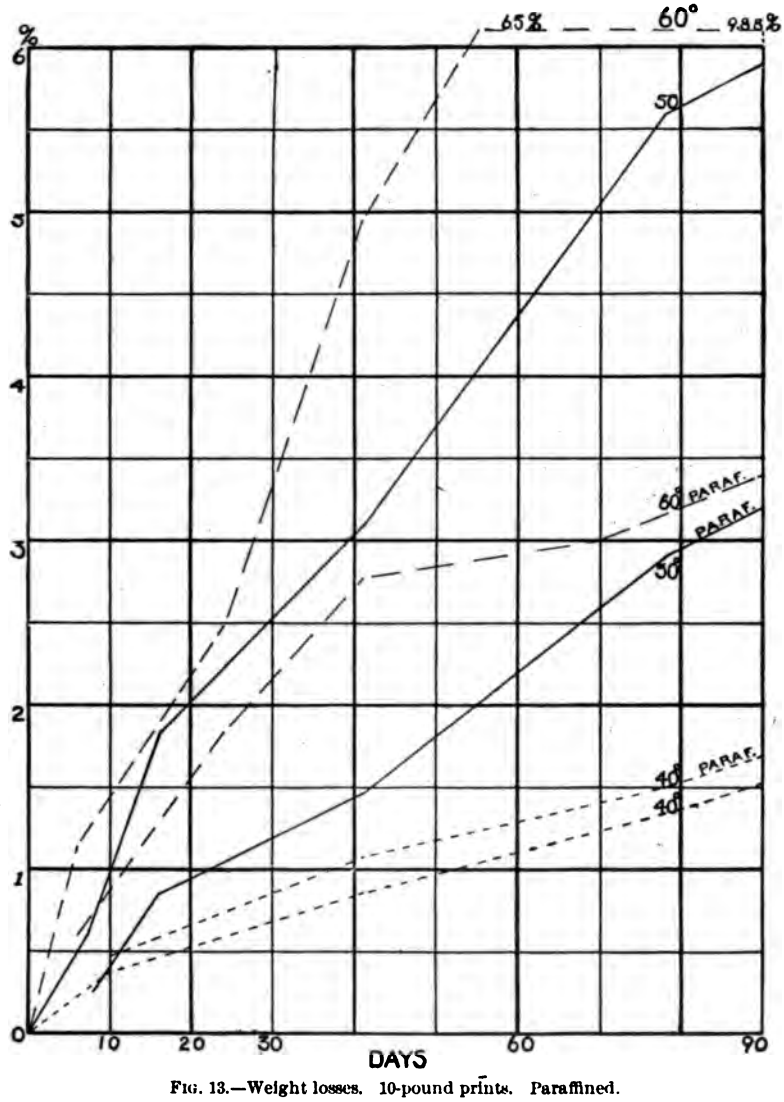


FIG. 13.—Weight losses. 10-pound prints. Paraffined.

50° this ratio was slightly diminished, but was in the same general direction. At 40° a peculiarity is observable in both the print and the daisy size, in that the paraffined cheese lost a trifle more than the unparaffined lot. We do not think this apparent paradox can be explained on the basis of errors in weighing, as there were five

unparaffined and seventeen paraffined print cheeses and twenty-four unparaffined and four paraffined 20-pound cheeses in these experiments. Also the weighings of these cheeses were made at frequent intervals and in every case the same relation was observed. Further experiments are in progress to test the accuracy of these observations.

In the paraffined cheese at 40° the losses were reduced practically to a minimum, as was also the case with the unparaffined at this temperature. As evaporation would certainly be lessened in the paraffined lot, the uniformity of loss between these and the unparaffined still further substantiates the view advanced earlier that these losses are not so much due to shrinkage from evaporation as they are to metabolic activities of organisms and possibly chemical transformations within the cheese.

PART II.—EFFECT OF TEMPERATURE ON QUALITY OF CHEESE.

A. COURSE OF CURING AT DIFFERENT TEMPERATURES.

Originally it was planned to have the cheese judged by commercial experts, but it was found impossible to arrange for a sufficiently large number of such tests to closely follow the progressive changes which occurred in the course of the ripening of the cheese. Hence, in addition to the examinations made by the jury of commercial experts, the cheese was carefully scored at Waterloo by Mr. Baer at frequent intervals. The full details of these examinations, which include numerical and descriptive scores, as well as the intrinsic value of the cheese at the different periods when it was examined, are presented in the appendix (p. 57.)

Course of Ripening in Type I.

This type was represented by four different lots of Wisconsin cheese. All of them were well-cooked, firm-bodied, slow-ripening cheese that may be regarded as typical Cheddars. In one case the milk from which the cheese was made was evidently tainted, as the cheese was slightly off at the outset.

The results of these periodical scores by Mr. Baer show that good cheese was produced at all temperatures in the first three lots. Naturally that cured at 60° developed more rapidly than the goods cured at lower temperatures, but it should be noticed that even at this temperature some of the firm-textured cheese went off in five months. At 50° and 40° the cheese was about six weeks to two months behind the 60° in development, but in time it reached as high as the 60° lot, and generally of a better quality, and kept this maximum condition much longer than the 60°. This enhanced keeping quality was more pronounced at 40° than at 50°.

In the lot made from tainted milk (La Crosse, p. 58) the imperfect condition was pronounced at all temperatures, but was more prominent at 60° than below.

In studying the detailed scores by Mr. Baer, presented in the appendix, it is possible to combine the numerical scores of the four different lots of Wisconsin cheese belonging to the same type and so obtain a set of averages, as to flavor, texture, and price, which indicate clearly the progress of the curing of these various lots at the different temperatures. In the following table these summaries are included:

Summary of scores and values of cheese in type I (firm export type).

Age (months).	Flavor (standard 45).			Texture (standard 30).			Price (standard 13 cents).		
	40°.	50°.	60°.	40°.	50°.	60°.	40°.	50°.	60°
1	33.3	34.3	35.8	23.3	22.3	24.3	.....	.....	.....
2	37	38.3	39	26	25.3	26.8	10	10.5	10.8
3	41.5	42.3	42.3	28.6	28.5	29	11.81	12.4	12.4
5	43	41	39.5	29.3	29	27.5	12.69	12	11.44
8	43.8	.....	.....	29	.....	.....	12.75	.....	.....

Flavor.—The variation in flavor observed at the different temperatures is more marked than any other characteristic. This range in flavor is also shown graphically in figure 14. From this it appears

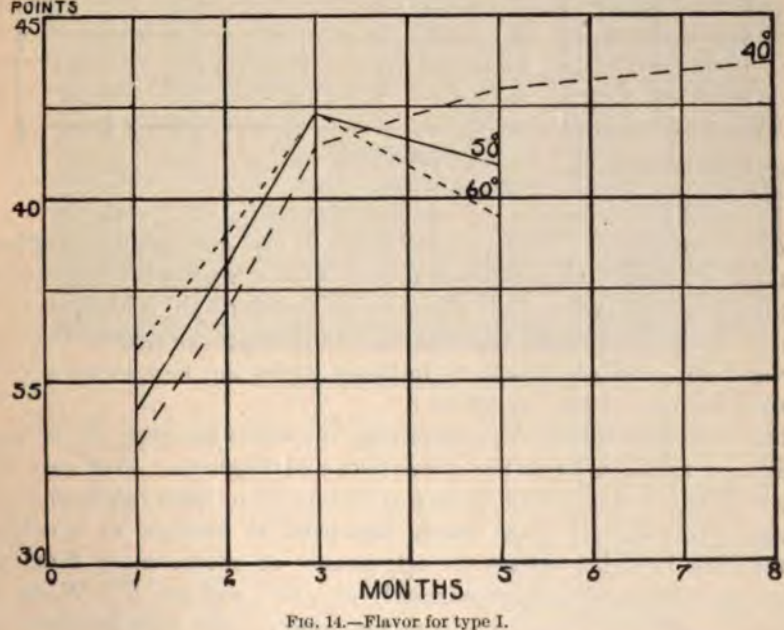


FIG. 14.—Flavor for type I.

that at the higher temperatures the flavor is more developed during the earlier ripening stages, but as the cheese increases in age the quality

of the flavor at the higher temperatures deteriorates more rapidly than in the cold-cured goods. At the end of five months the 40° was still improving, and even at this time was higher than at any period with the 50° and 60°. At present writing (eight months), the cold-cured cheese is still of excellent quality, and shows no signs of deterioration.

Texture.—The texture of the cheese followed quite closely a development similar to that noted under "Flavor." In the earlier stages the 60° had the highest score, but it reached its maximum in three months, while the 50° and 40° continued to improve up to the end of the test, and was higher in the 40° at this time than at any time in the 60°. This condition is shown in figure 15.

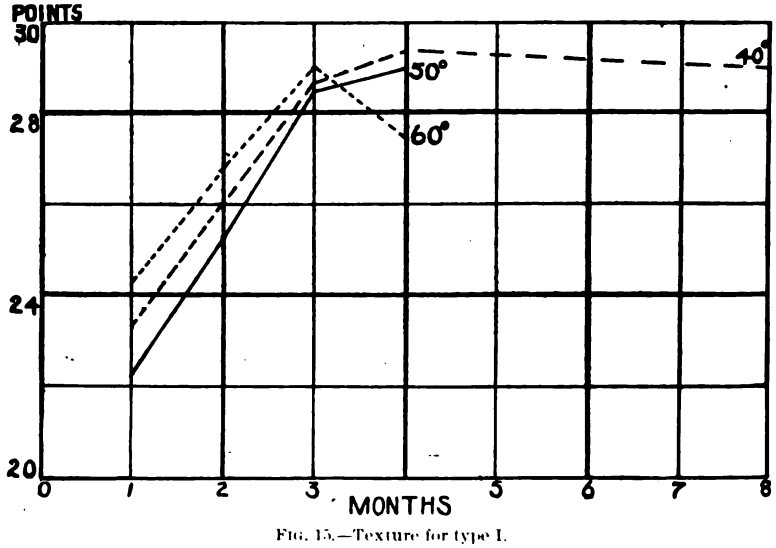


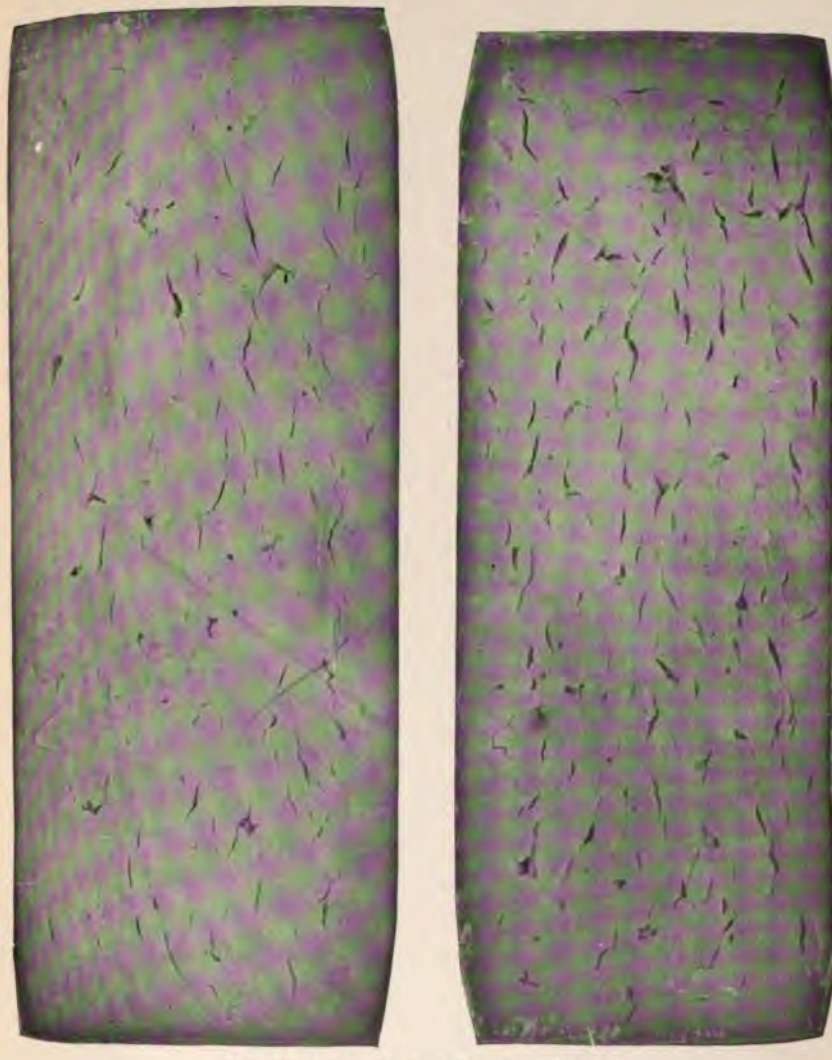
FIG. 15.—Texture for type I.

Price.—Figure 16 presents the range in intrinsic value throughout the test. The improved condition with reference to flavor and texture naturally reappears in this commercial standard, in which the 40° cheese, while developing somewhat more slowly, soon passes both the 50° and 60°, and continues to improve while the two latter decline toward the end of the experiment.

The beneficial effect of cold-curing on this firm type of cheese is strikingly apparent from the above data and diagrams. Not only was this cold-cured cheese free from any bitterness or taint incident to the curing process, but it was much improved in texture, as is evident from Plate I, which shows the appearance of cheese made from the same vat but cured at approximately 40°, 50°, and 60° F. When the cheese is cold cured the body is much closer, as the curd particles are subject to more pronounced shrinkage at higher temperatures, which causes the formation of these irregular, ragged cracks. This is per-

THREE CHEESE SECTIONS—TYPE I.

Cheese at top cured at 40°, in middle at 50°, and at bottom at 60°.



Two Vertical Cheese Sections—Type I.

Cheese cured at 40° on left and cheese cured at 60° on right.

haps rendered more obvious in Plates II and III, in which the cheese cured at 40° and 60° are shown. When it is remembered that the results ordinarily obtained in factory curing are not anything like as satisfactory as those shown in the cheese cured at 60°, the improvement in quality, as shown by the texture of the cheese cured by the cold-curing process over that now in vogue, is emphasized still more.

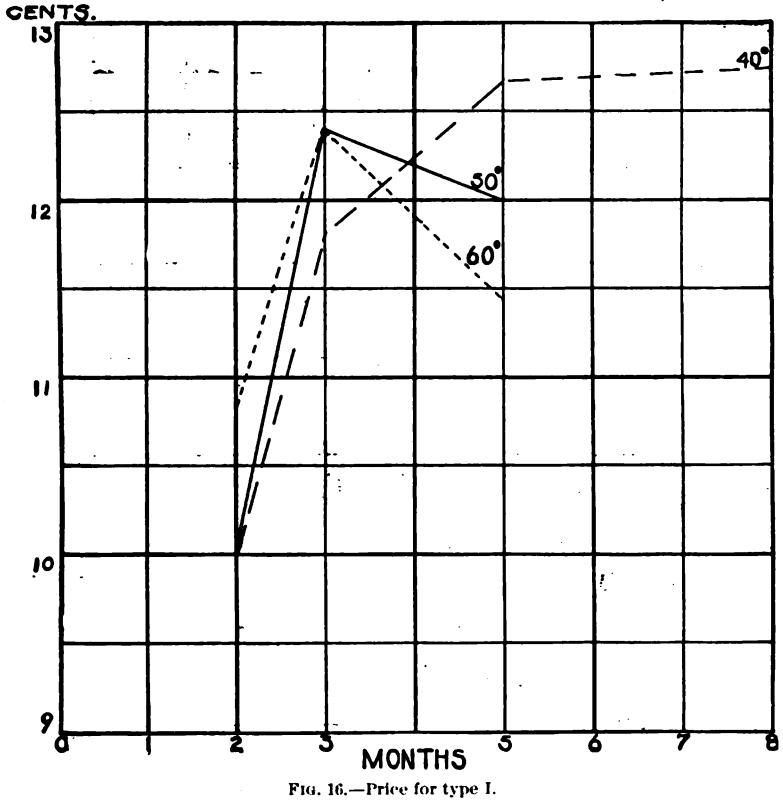


FIG. 16.—Price for type I.

The 50° cheese stands intermediate between the distinctively cold-cured product and that obtained under best present conditions without artificial refrigeration. Emphasis has already been laid upon the fact that a considerable improvement in quality is to be expected where a slight diminution in temperature is secured over that found in the best type of factory curing now in vogue. This system of "cool-curing"—that is, the use of a temperature from 52° to 58° F., as recently advocated by the Canadian authorities[a]—stands midway between the cold-curing process and the system now most frequently in use. The benefits to be gained by this system are evident from the Canadian experiments, in which 480 pairs of cheeses were cured, one

[a] J. A. Ruddick in paper presented at the Ontario Dairymen's Association, January, 1903.

of each lot being kept at 52° to 58°, while the other was ripened in an ordinary curing room (61° to 70°). Quoting Mr. Ruddick's paper, he

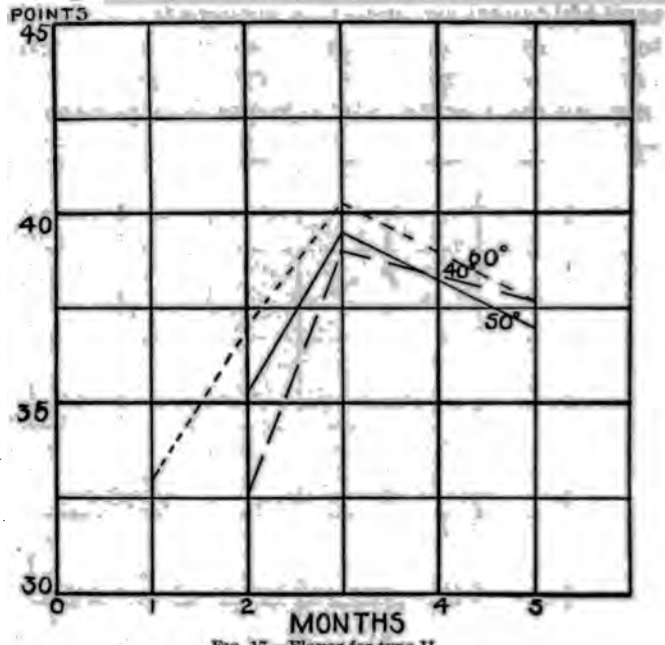


FIG. 17.—Flavor for type II.

says that "in every case the cool cured (cheese) has been pronounced the best in quality."

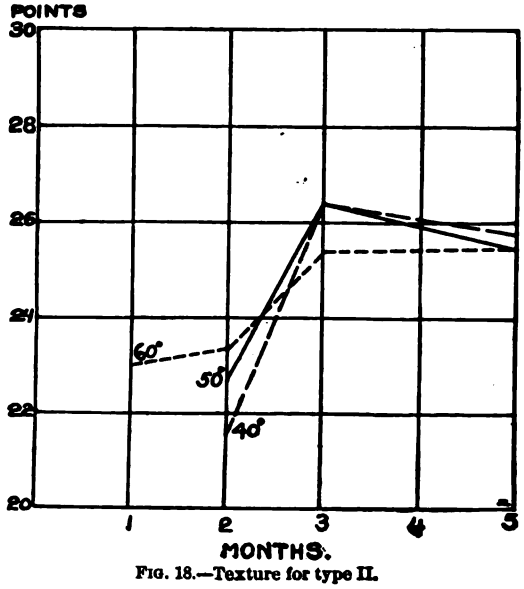


FIG. 18.—Texture for type II.

From the experiments detailed above it appears that further improvement in quality is possible if the curing temperature is still

rther reduced (40° to 50° F.). It must be remembered in this comrison that the highest temperature we employed is much lower than e average factory curing room. The difference in quality between ld-cured and ordinary-cured cheese would be much greater than at represented in this work.

The cheese of this type at 60° ripened rapidly and showed an excelit quality in all lots but one, which was tainted from the beginning, t they all passed their prime in three months and showed marked terioration by the end of five months.

With this type of cheese it must be remembered that the quality of e flavor produced at low temperatures is quite different from that and at 60°. Cold-cured cheese possesses a very mild but perfectly an flavor, together with a solid waxy texture.

Course of Ripening in Type II.

The cheese in this type is not so uniform in its make-up as that of pe I, but it represents that type of American product in which less id is developed than is found in the normal Cheddar cheese. This eese is more open in texture and contains a considerable number of echanical and small Swiss holes as shown in Plate III. The cheese s somewhat low in flavor, due in all probability to the milk and ethod of manufacture, and not to the curing, as this defect was quite apparent at the lower temperatures as at 60°.

The Iowa cheese was found to be of only fair quality, but at all es was better at 40° than at other temperatures, although the differce is considerably less than it was with the firmer Wisconsin type of eese.

The Illinois cheese was quite similar to the Iowa lot, but the texture this cheese at 60° was considerably more impaired than that tained at the lower temperatures.

The following table gives the summary of the scores of these two s (Iowa and Illinois) taken at intervals during the life of the eese.

Summary of scores of cheese and values in type II (sweet-curd).

Age in months.	Flavor (standard 45).			Texture (standard 30).			Price (standard 13 cents).		
	40°.	50°.	60°.	40°.	50°.	60°.	40°.	50°.	60°.
.....	.....	.....	35	.....	.....	22	.....	.....	9.5
.....	37.5	38	36.5	23.5	25	22	10	10.25	9.75
.....	40.5	40.5	40	27	26	23.5	11.7	11.13	10.87
.....	39	38	35	26	26	25	11	10.75	10.25

In the accompanying diagrams the above tabular data are pictoriy represented.

Flavor.—Figure 17 shows the course of development of the flavor. While there was not much difference in the maximum flavor produced (one-half point), still the cold-cured cheese maintained a higher flavor than the 60° throughout the whole experiment. The rapid deterioration of the 60° was especially marked.

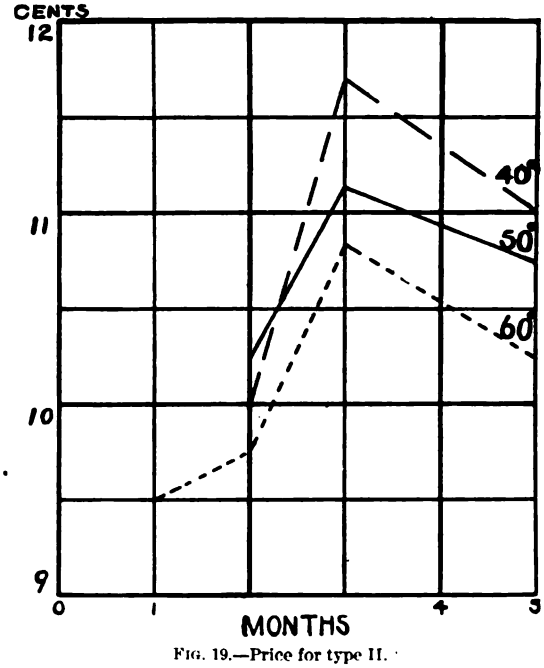


FIG. 19.—Price for type II.

Texture.—In texture, both the 40° and 50° were much superior to the 60° cheese, as is evident from figure 18.

Attention should also be directed in Plate III to the presence of the numerous white specks which only appear in the cold-cured cheese.

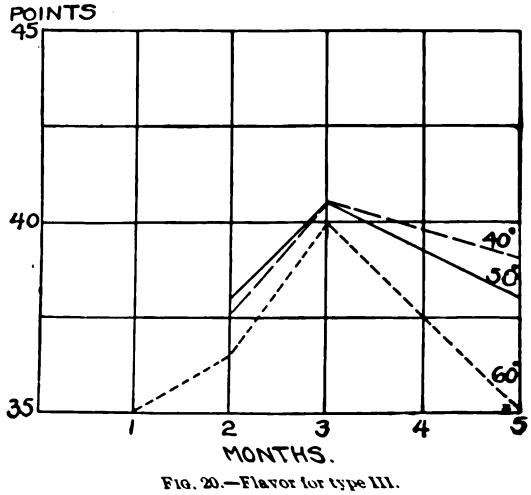
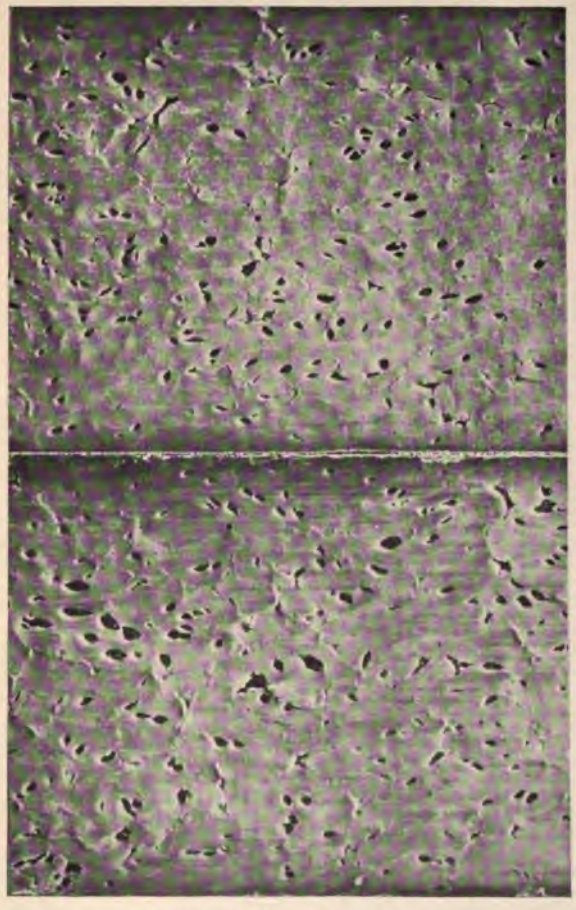


FIG. 20.—Flavor for type III.



TWO CHEESE SECTIONS—TYPE II.

Cheese cured at 40° on top, cheese cured at 60° on bottom.

These small spots have always been found in our cheese cured at temperatures of 50° and below.

Price.—The commercial standard shows again the improvement in value and the maintenance of this improved condition for a longer period of time, as is evident from figure 19.

COURSE OF RIPENING IN TYPE III.

This type represents the softer make of cheese intended for home trade, and one which cures more quickly, and therefore does not keep

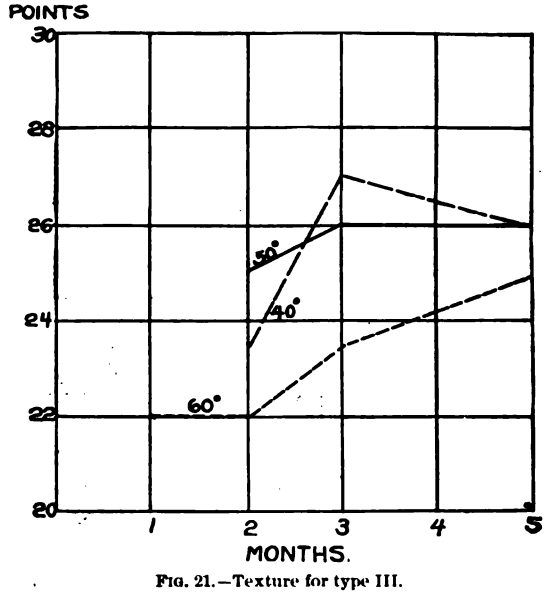


FIG. 21.—Texture for type III.

as long as the firmer Cheddar type. This type is represented by four different lots of Michigan cheese made at the same factory. They were not of standard quality, but were too acid. The first three lots were materially delayed in transit and consequently had undergone considerable change before being cold-cured. From the detailed data given in the appendix (p. 68–70) it is evident that lot 4 was the best, and in this lot the 40° and 50° were both better than the 60°.

The average results at the different temperatures are shown in the following table:

Summary of scores and values of cheese in type III (soft Michigan cheese).

Age (months).	Flavor (standard 45).			Texture (standard 30).			Price (standard 13 cents).		
	40°	50°	60°	40°	50°	60°	40°	50°	60°
1	.....	.....	33	.....	.....	23	.....	.....	9
2	32.6	35.3	37	21.7	22.7	23.3	9.3	10.2	10.5
3	39	39.5	40.2	26.3	26.3	25.3	11.25	11.4	11.5
5	37.7	37	37.7	25.8	25.5	25.5	10.4	10.2	10

Flavor.—In this case the flavor of the 4 lots was poor, only once exceeding 40 points. While the 60° scored higher at one time than the cheese at the other two temperatures, the 40° cheese at five months equaled the flavor of the higher temperature cheese at this time, as is shown in the table and also in figure 20.

Texture.—Figure 21 shows graphically the texture scores presented in the above table. The 60° cheese was materially better in the beginning, but fell slightly behind at the three months' period.

Price.—The difference in price of this cheese at three months was inconsequential, and from this date the cheese at all temperatures fell off rapidly in value as shown in figure 22.

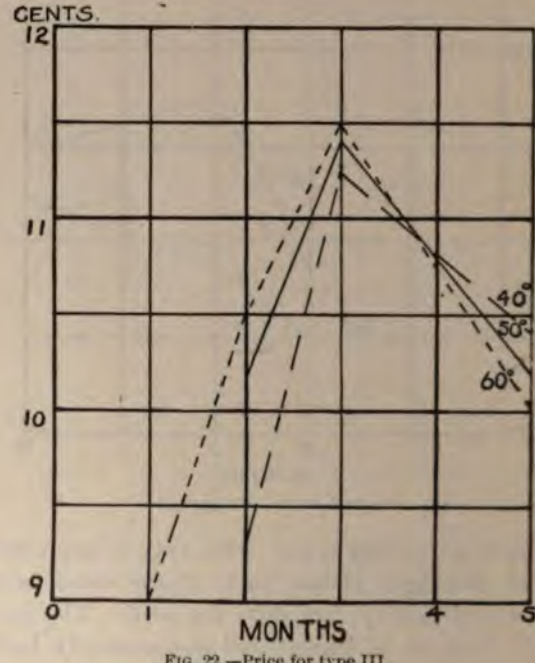


FIG. 22.—Price for type III.

All four lots of these Michigan goods were more or less delayed in transit, although lot four was no more so than some of the cheese in the other types. But with this moist, quick-curing cheese it was much more susceptible to temperature influences, and hence was materially impaired before being put in storage. This condition, taken in connection with the inferior make (high acid), renders this part of the experiment unsatisfactory.

B. EXAMINATION BY COMMERCIAL EXPERTS.

In accordance with the plan originally outlined, the cheese in these experiments was subjected to a close examination by a jury of commercial experts, who had no knowledge as to the previous treatment

which the cheese had received. The complete data as to their scores, price assigned, etc., are given in the appendix (p. 57). From these data the following table of averages for each lot of cheese is compiled, including the scores made when the cheese was, respectively, three and five months old:

Comparison of average numerical and commercial scores made by jury when the cheese was 3 and 5 months old.

FIRST JURY TEST (3 MONTHS).

	At 40°.				At 50°.				At 60°.			
	Flavor.	Text.	Color.	Price.	Flavor.	Text.	Color.	Price.	Flavor.	Text.	Color.	Price.
Type I (typical Cheddar).												
Wisconsin:												
T. J., Boaz	41.3	25.8	11.8	12.3	43.3	27.6	14.3	12.6	42.3	28.6	14.0	12.4
H. J. N., Muscoda	42.3	26.3	15	12.2	44.1	27.8	15	12.6	43.6	27.8	15	12.5
P. H. K., Nicholson	44	28.6	14.8	12.8	44	28.3	14.6	12.6	43	26.3	14.2	12.3
La X, La Crosse	43.3	28.6	14.3	12.6	43	28.3	14.3	12.6	42	27.3	14.3	12.3
Total	170.9	109.3	55.9	49.9	171.4	112	58.2	50.4	171.9	110	57.5	49.5
Average	42.7	27.3	14	12.5	43.6	28	14.5	12.6	43	27.5	14.4	12.4
Type II (sweet-curd).												
Iowa:												
E. G. H., Union	42.6	27.6	13.6	12.3	42.6	26.6	13	12.2	42.6	28	13.2	12.4
Illinois:												
J. B. G., Sterling	40.6	25.6	14.3	11.2	40	25	14	11.1	40	24.6	14	11.1
Total	83.2	53.2	27.9	23.5	82.6	51.6	27	23.3	82.6	52.6	27.2	23.5
Average	41.6	26.6	13.9	11.7	41.3	25.8	13.5	11.6	41.3	26.3	13.6	11.7
Type III (soft).												
Michigan:												
A. H. B., Merrill, I	39.6	26.0	13	11.9	40.6	26.6	13	12.2	41	26	13.	12.2
A. H. B., Merrill, II	40.6	26.3	12.5	11.8	41.6	27.6	13.3	12.1	40	26.6	12.6	12
A. H. B., Merrill, III	40.3	27.3	13	11.3	42.6	28	13.3	12	40.3	26.3	13	11.5
A. H. B., Merrill, IV	42	28	13.6	12.3	41	26.6	12.6	11.8	42	27	12.6	12
Total	162.5	107.6	52.1	47.3	165.8	108.8	52.2	48.1	163.3	105.9	51.2	17.7
Average	40.6	26.9	13	11.8	41.4	27.2	13	12	40.8	26.5	12.8	11.9

Comparison of average numerical and commercial scores made by jury when the cheese was 3 and 5 months old—Continued.

SECOND JURY TEST (5 MONTHS).

	At 40°.				At 50°.				At 60°.			
	Flavor.	Text.	Color.	Price.	Flavor.	Text.	Color.	Price.	Flavor.	Text.	Color.	Price.
Type I (typical Cheddar).												
Wisconsin:												
T. J., Boaz	43.5	28.5	15.0	12.8	40.0	28.5	15.0	12.5	38.5	28.5	15.0	12.1
H. J. N., Muscoda	44	29.5	15	13	43.5	28.5	15	12.9	43	28	15	12.8
P. H. K., Nicholson	41	28	15	12.6	41.5	28.5	15	12.6	42	28.5	15	12.8
La X, La Crosse	41	27.5	13.5	12.1	40	26.5	12.5	11.9	35	25	14	11
Total	169.5	113.5	58.5	50.5	165	112	57.5	49.9	158.5	110	59	49
Average	42.4	28.4	14.6	12.6	41.2	28	14.4	12.5	39.6	27.5	14.7	12.2
Type II (sweet-curd).												
Iowa:												
E. G. H., Union	41.5	26	13	12	39.5	25	13	11.5	.....	.....	.....	.....
Illinois:												
J. B. G., Sterling	38.5	24.5	13.5	11	39	25.5	13.5	11.1	39	25	13.5	11
Total	80	50.5	26.5	23	78.5	50.5	26.5	22.6	.....	.....	.....	.....
Average	40	25.2	13.2	11.5	39.2	25.2	13.2	11.3	39	25	13.5	11
Type III (soft).												
Michigan:												
A. H. B., Merrill, I	36	26	11	11.6	36.5	26.5	11.5	11.8	37	26.5	11	11.6
A. H. B., Merrill, II	40	26	11	11	38.5	25.5	11	11	37.5	25.5	11	11
A. H. B., Merrill, III	38	27	13	11.3	39.5	25.5	11	11.4	38.5	26	12.5	11.4
A. H. B., Merrill, IV	43	27	12	12.3	42.5	27.5	12.5	12.3	40.5	25	11	11.8
Total	157	106	47	46.2	157	105	46	46.5	153.5	103	45.5	45.8
Average	39.2	26.5	11.7	11.5	39.2	26.2	11.5	11.6	38.4	25.7	11.4	11.4

In the first test the jury consisted of Messrs. White, Millar, and Kirkpatrick. In the second test, made when the cheese was 5 months old, one of the judges (Kirkpatrick) was unfortunately unable to assist. It is therefore impossible to compare with each other the average scores secured in these two tests, as the judgment of the different members of the jury naturally is not uniform. In comparing, therefore, the course of ripening in the three and five months' tests, it will be necessary to correct the averages given by eliminating the score of the judge who was absent in the second test.

For purposes of study, however, the two tests can be considered independently and the influence of the different temperatures on the character of the cheese determined.

Results of First Jury Trial.

When the cheese had been cured for three months, the sample cheese which had been tested previously at monthly intervals by Mr. Baer, was shipped by refrigerator service to Chicago and submitted to the jury for examination. In the appendix (p. 62) are given the

Three Cheese Sections—Illinois Cheese.

Cheese at top cured at 40°, in middle at 50°, and at bottom at 60°.

detailed data collected at this time. The average of these scores for the different types of cheese and at different temperatures is presented in the table on page 45. Necessarily these data must be discussed on the basis of the different types and not considered together. When this is done the following conclusions appear to be warranted.

Type I (*firm, solid, export cheese*).—In the four lots of cheese which comprised this group the 50° product was higher in flavor twice, the 40° once, and once the 40° and 50° were alike. In no case, even at this age, when the 60° cheese was at its best (as shown by the serial examinations made by Mr. Baer), did this cheese reach as fine a flavor as at the lower temperatures.

In texture the 40° lot was ahead twice, once the 50° and 60° were alike, and once the 60° was the highest.

As to price, in no case did the 60° equal the value set upon the cheese cured at the lower temperatures, although the difference given by the judges was slight. It must be remembered that the price assigned by the commercial jury was influenced materially by the fact that there is considerable difference in quality, even among the best types of cheese, without a corresponding difference in price. In the majority of cases, when the cheese scored within one or two points of perfect, the price was cut from a quarter to a half cent below the market standard (13 cents), simply because the appearance of the cheese on the surface (mold, etc.) warranted this reduction from a purely commercial point of view. The judges were free to admit that intrinsically the cold-cured cheese was of much better quality than is usually obtained in the market. This cheese was box-cured and received no especial care throughout the experiment; consequently the exterior appearance of the same had been impaired. With proper control this condition could have been entirely obviated, as we have been able to show repeatedly where cheese was cold-cured under our direct supervision.

Type II (*sweet-curd cheese*).—In this type, in which less acid was developed, little or no difference was observed in the Iowa goods; but in the Illinois cheese the 40° product had a better flavor and texture than the cheese cured at 50° or 60°. Plate IV shows the appearance of the Illinois cheese cured at the three temperatures when 3 months old.

Type III (*soft, home-trade cheese*).—This type is represented by four different lots from the same factory. All of the lots were highly acid and were of somewhat inferior make. Then, too, the earlier lots were delayed in transit from the factory to the curing station, so that the results of the experiment should not be considered as necessarily typical of the cold-curing process. In this group of four tests the 50° goods were ahead twice on flavor, the 60° once, and once the 40° and 60° were alike. In texture the 50° was highest three times out of four.

GENERAL SUMMARY OF THE FIRST (THREE MONTHS) TEST.

The cheese was examined at this date by the commercial judges, as it was thought that the highest temperature cheese (60°) had reached its maximum condition. It was naturally expected that the 60° product at this time would rank higher in quality than the cold-cured goods. From the above data, it is evident that such a condition did not obtain, as is indicated in the following summary of scores:

Summary of average scores for types I, II, and III, at three months.

	At 40°.	At 50°.	At 60°.
Average scores of ten lots on flavor	41.66	42.28	41.78
Average scores of ten lots on texture	27.01	27.24	26.88
Number of times each lot has highest score on flavor	2	4	1
Number of times each lot tied on score on flavor	3	2	2
Number of times each lot had highest score on texture	3	5	3
Number of times each lot tied on score on texture	0	1	1

From this it appears that the 50° cheese was superior in flavor and texture, not only on the basis of the total scores, but also as to the number of times they ranked highest or equal to the cheese cured at either of the other temperatures. This test was made before the 40° goods were marketable, but even at this time this cheese compared favorably with the 60° product.

RESULTS OF SECOND JURY TRIAL.

The second commercial scoring was made at the end of five months, at which time it was thought that the cold-cured goods could best be judged from a market point of view. The results of this scoring follow:

Type I.—In the four lots tested of this firm-bodied cheese, the 40° was highest in flavor three times and the 60° once. Averaging the total scores shows that the 40° cheese scored 2.8 points higher than the 60°, and even the 50° was 1.6 points above the cheese held at what has been considered ideal curing conditions.

In texture the 40° was highest twice, while in the other cases the scores were equal. Numerically, the average texture of the 40° was nearly a point above the 60°. At this age the 60° goods began to show signs of deterioration, while the cold-cured goods kept much better.

Type II.—In this test one lot of the 60° goods (Iowa) was mislaid in transit, and hence was not tested, but in this case the 40° was 2 points above the 50° in flavor, and 1 point on texture. In the Illinois cheese but little difference was observed.

Type III.—In this softer cheese, twice the 40° scored highest in flavor, the 50° and 60° once each. On texture the 40° scored highest twice, the 50° once, and the 50° and 60° tied once.

GENERAL SUMMARY OF SECOND (FIVE MONTHS) TEST.

In this test the average score, as well as the number of times any lot has scored the highest, shows that the 40° cheese was superior to those at either of the other temperatures, while at this age the 60° cheese showed that it had passed its prime. The summary of these scores is indicated below:

Summary of average scores for types I, II, and III, at five months.

	At 40°.	At 50°.	At 60°.
Average scores of nine lots on flavor	40.65	40.05	39.0
Average scores of nine lots on texture	27.0	26.75	26.4
Number of times each lot had highest score on flavor	6	1	2
Number of times each lot tied on score on flavor	0	1	1
Number of times each lot had highest score on texture	5	2	0
Number of times each lot tied on score on texture	1	3	3

COMPARISON OF THE FIRST AND SECOND JURY TRIALS AS INDICATING THE KEEPING QUALITY OF THE CHEESE.

It is important to compare the scores of the commercial judges made at the first and second jury trials, as in this way it is possible to study the keeping quality of the cheese cured at different temperatures. Unfortunately one of the judges could not be present at the second test. Therefore the judgment of the other two has been used in comparing the data of the two tests. The average scores of flavor and texture of these judges, made at the first and second trials, are given below:

Comparison of average scores made by the same judges at the 3 and 5 months' tests.

Type.	At 40° F.			At 50° F.			At 60° F.		
	Three months.	Five months.	Difference.	Three months.	Five months.	Difference.	Three months.	Five months.	Difference.
Flavor (standard 45).									
I	42.4	42.4	0	43.2	41.2	2	42.5	39.6	2.
II	41.5	40	1.5	41.3	39.2	2.1	41	39	2
III	40.3	39.2	1.1	40.8	39.2	1.6	40.4	38.4	2
Texture (standard 30).									
I	27	28.4	[a] −1.4	27.8	28	−0.2	27.2	27.5	−0.3
II	26.5	25.2	1.3	25.8	25.2	0.6	26	25	1.0
III	26.1	26.5	−0.4	27	26.2	0.8	26	25.7	0.3
Price (standard, 15 cents).									
I	12.4	12.6	0.2	12.6	12.5	0.1	12.4	12.2	0.2
II	11.7	11.5	−0.2	11.6	11.3	0.3	11.7	11	0.7
III	11.6	11.5	0.1	11.9	11.6	0.3	11.9	11.4	0.5

[a] Where quality improved with age instead of deteriorating, it is indicated in column of difference by the use of the minus sign.

The above table is instructive in showing the progress of the curing at three and five months periods.

Type I.—With reference to flavor, type I showed its better keeping qualities, inasmuch as it held its own at 40°, while at 50° the cheese had deteriorated 2 points and at 60° 2.9 points. The texture improved at all temperatures as the age increased, but was much more pronounced (over a point) at 40° than at 50° or 60°. This improvement in flavor and texture is also reflected in the enhancement in commercial value. The 40° gained 0.2 cent per pound in three to five months, while the 50° fell off 0.1 cent and the 60° 0.2 cent per pound. Thus in all ways the advantage of cold curing is evident on this firm, solid type of the Wisconsin cheese.

Type II.—In this type, in which less acid was developed than in the typical Cheddar type, the deterioration in flavor was less at 40° than at either 50° or 60°. In texture, however, all scored lower at five months, the data showing a wider difference at 40° than at the other two temperatures. In price, however, the cheese was considered to be worth 0.2 cent per pound more at 40°, while the 60° cheese had depreciated 0.7 cent.

Type III.—In the softer Michigan make, in which more rapid deterioration would be expected, the falling off in flavor was 2 points at 60° as against 1.1 points at 40°. In texture the 40° improved 0.4 point, while the other two depreciated 0.8 and 0.3 point, respectively. In price, all these goods were of less value at five months than at three, but they had depreciated 0.5 cent at 60° and only 0.1 cent at 40°.

Summarizing the above, there can be no question but that the keeping quality of all of these various types of American cheese is improved by curing them at these lower temperatures. This is more evident with the firm, solid Wisconsin type of Cheddar than with the softer, quick-curing goods; but even these can be held with less deterioration at these temperatures than is possible under present curing conditions.

SUMMARY OF EFFECT OF TEMPERATURE ON QUALITY.

As the three different types of cheese represented in these experiments varied so much in character, it will be fairer to state the conclusions with relation to each separately. The scores on these lots of cheese were made separately by our own cheese expert throughout the whole curing period, and also at stated intervals by the commercial judges.

Type I (firm-bodied, typical Cheddar cheese).—At 60° F. flavor developed more rapidly than at lower temperatures, but the maximum score at this temperature, as indicated by Baer, was equaled or exceeded by the maximum score at 50° or 40°. In the scoring made by the

commercial jury the 50° averaged 0.6 point higher than the 60°, when cheese was 3 months old. When 5 months old, the 40° was 2.8 points higher than the 60°, and the 50° 1.6 points higher.

In texture the course of development was quite the same, the judges scoring the 50° ahead at 3 months, but at 5 months the 40° averaged nearly a point higher than the 60°.

Type II (*sweet-curd type*).—In this low-acid cheese the course for ripening followed the same rule as in the above type, although this cheese was inferior in quality to the preceding type.

Type III (*soft home-trade type*).—The results on this quick-curing type of cheese were affected by the delay in transit, which permitted of a considerable degree of ripening before the cheese was put in the curing rooms. In this type of cheese the improvement was less marked, but when the enhanced keeping quality is considered, the cold-curing process was found to be advantageous even under these advanced conditions.

C. INFLUENCE OF PARAFFINING ON QUALITY OF CHEESE.

With the use of lower temperatures for curing, a higher degree of saturation of the atmosphere is always found, which greatly promotes the development of mold, and this growth injures the salability, though not the quality, of the cheese, and hence many attempts have been made to overcome the difficulty. The most efficient method yet proposed is to coat the surface of the cheese with an impervious layer, which, by excluding oxygen, prevents development of molds. For this purpose the cheeses are immersed in a bath of melted paraffin, which, upon cooling, adheres closely to the surface. While this effectually accomplishes the desired end, it is a question of importance whether the quality of the cheese so treated is affected prejudicially or not. It is possible to conceive that the retention of all volatile decomposition products within the cheese might injure the flavor of the product.

In these cheese-curing experiments it was thought advisable to institute a series of trials to determine what influence paraffining had on the quality, as shown by the flavor and texture scores. For this purpose the cheese which was used in the experiments on shrinkage (La Crosse lot) was scored by Mr. Baer, and was also submitted to the experts for scoring at the regular periods. These scores are to be found in the appendix (pp. 58 and 64), but, in order to permit of a more

ready comparison, a summary of the flavor and texture scores of the paraffined and the normal cheese is presented in the following table:

Comparative scores of paraffined and unparaffined cheese (daisies and 10-pound prints).

20-POUND DAISIES.

Curing temperature.	Age by months	Flavor.				Texture.			
				Difference.				Difference.	
		Paraffined.	Unparaffined.	Paraffined.	Unparaffined.	Paraffined.	Unparaffined.	Paraffined.	Unparaffined.
40° F	1	.....	39	.....	.....	.....	28	.....	.....
	2	39	34	.....	4	22	26	.....	4
	3	43.5	40	3.5	.....	29.5	29	0.5	.....
	a3	43.3	43.3	0	0	28.6	28.6	0	0
	5	40	40	0	0	29	28	1	.....
	a5	41.5	41	0.5	.....	27	27.5	.....	0.5
50° F	1	.....	30	.....	.....	.....	24	.....	.....
	2	33	35	.....	2	23	27	.....	4
	3	41	40	1	.....	28	29	.....	1
	a3	43	43	0	0	28.6	28.3	0.3	.....
	5	39	38	1	.....	28	27	1	.....
	a5	40.5	40	0.5	.....	28.5	28.5	0	0
60° F	1	30	28	2	.....	22	26	.....	4
	2	33	30	3	.....	26	27	.....	1
	3	38	38	0	0	27	29	.....	2
	a3	41.3	42	.....	0.7	27.6	27.3	0.3	.....
	5	38	35	3	.....	28	25	3	.....
	a5	39.5	35	4.5	.....	28	25	3	.....

10-POUND PRINTS.

40° F	1	38	38	0	0	22	22	0	0
	2	38	38	0	0	25	25	0	0
	a3	43.3	43	0.3	.....	28.3	27.6	0.7	.....
50° F	1	38	38	0	0	24	24	0	0
	2	41	41	0	0	26	26	0	0
	a3	43.3	43.3	0	0	28.6	28	0.6	.....
60° F	1	40	40	0	0	25	25	0	0
	2	43	42	1	.....	28	27	1	.....
	3	45	44.5	0.5	.....	29.5	29.5	0	0
	a3	43.3	42.6	0.7	.....	28.6	28.6	0	0

a This indicates that the score made at this time was by the commercial experts. Scores of same date not bearing reference mark are by Mr. Baer.

From these data it is evident that the difference between the same lot of cheese when paraffined or unparaffined is very slight. If the course of curing is considered, as is shown by the scores of Mr. Baer, which were taken when the cheese was 1, 2, 3, and 5 months old, it is apparent that the application of paraffin has not injured either the flavor or the texture of the cheese. By reference to the column headed "Difference" in the above table, it will be further noted that in the daisies the unparaffined cheese was, with one exception (60°),

better at the beginning; but throughout the remainder of the curing and to the end of the experiment the paraffined improved much more rapidly, and without exception was as good as or better than the unparaffined.

With the prints the difference in scores was practically negligible.

This same cheese was scored by the commercial experts when it was three and five months old, and it should be noted that the opinions of these experts coincided quite closely with those of Mr. Baer.

It would be unsafe from these limited experiments to draw any general conclusions, but so far as they go these trials show that no injurious effect was observed on either the flavor or the texture of the paraffined cheese.

GENERAL SUMMARY.

The purpose of the experiments detailed above was to test the value of low temperatures for the curing of cheese made under widely different but commercial conditions. To accomplish this purpose, it was deemed advisable to purchase the product from a wide range of territory. This condition rendered it impossible to install the cheese in the curing rooms immediately after it was taken from the press, and hence the full effect of the process is not so evident as would have been the case if the cheese had not had any preliminary curing.

Naturally a comparison of the cold-curing process would be made with the conditions most frequently found in factories, but in these studies the low temperature cured product has been compared with cheese ripened at about 60° F.—a temperature which has hitherto been considered as the best for the ripening of Cheddar cheese.

EFFECT ON SHRINKAGE.

When cheese is cold-cured, the losses due to shrinkage in weight are greatly reduced over what occurs under ordinary factory conditions.

(1) *Influence of temperature.*—Cheese cured at 40° F. decreased in weight in ninety days from 1 to 1.4 per cent, while that cured at 50° and 60° F. lost fully three times as much. This saving would be still further increased if comparison were made between the results of cold curing and existing factory conditions. Under prevailing factory practice cheese is sold at a much earlier date than is advisable with cold-cured goods, but the loss under present conditions, for even as brief a curing period as twenty days, is fully four times as great as has occurred in these experiments in a ninety-day period (the minimum curing period recommended) under cold-curing conditions (40° F.). This saving in a factory making 500 pounds of cheese daily would average not less than 15 pounds of cheese per day for the entire season, or considerably more than this if only summer-made cheese was cold cured.

(2) *Influence of type of cheese.*—In these experiments different types of cheese were used, ranging from the firm, typical Cheddar to the soft, moist, quick-curing cheese made for the home trade. The losses with the firmer type were considerably reduced in comparison with the other, but the conditions to which the softer types of cheese were subjected were not as favorable (because of initial delays), and hence the losses with these types can not be relied upon with such definiteness. As this cheese was exceedingly moist, the total losses from the press were undoubtedly greater than here reported.

(3) *Influence of size of cheese.*—The size of package exerts a marked effect on the rate of loss. At ordinary temperatures, the smaller the cheese the more rapidly it dries out. This difference in loss diminishes as the temperature is lowered, and in our experiments at 40° F. was practically independent of the size. This condition, however, was undoubtedly attributable to the relative humidity of the curing room, which at 40° F. was 100 per cent.

(4) *Influence of paraffin.*—By coating the cheese with melted paraffin the losses at 60° were reduced more than one-half at 50°; the saving was somewhat less, and at 40° the losses observed on the paraffined cheese of both sizes used were slightly in excess of those noted on the uncoated cheese.

(5) As some loss occurs even in a saturated atmosphere, where evaporation is presumed not to take place, it implies that the shrinkage in weight of cheese under these conditions is not wholly due to desiccation, but is possibly affected by the production of volatile products that are formed by processes inherent in the curing of cheese.

EFFECT ON QUALITY.

(6) The three types of cheese above referred to can scarcely be compared closely with each other, as they were so different in their make-up and subjected to somewhat different conditions during transit. By far the most satisfactory portion of the experiment is that which relates to type I, in which the best quality of cheese was represented. With these firm, typical Cheddars the influence of temperature on curing could best be studied. This cheese was also placed in storage nearer the press than any of the other types, and hence the test as to the effect of the curing temperature was more satisfactory. In this type the 60° cheese was of excellent quality and naturally developed faster than the cold-cured goods, but in time it was surpassed by the cheese at the lower temperatures (50° and 40°), and, when the keeping quality of the latter was taken into consideration, it was found to be superior in every way to that cured at 60°. Even when the condition of the milk was not entirely perfect, the quality of the cold-cured cheese was better, although the original taint was not removed.

With the sweet-curd (type II) and the soft home-trade cheese (type

III) the effect of the disturbing influences previously noted rendered it impossible to obtain as satisfactory results, but, even under these adverse conditions, the 40° and 50° cheese generally ranked better than the 60°, and, when keeping quality was taken into consideration, was materially better.

This same cheese was also scored independently by commercial experts when three and five months old. The results obtained conform very closely to those mentioned above, and indicate the superiority of the cold-cured product (either at 50° or 40°) in comparison with the cheese cured at 60°. This improvement in quality reflects itself also in the commercial values which were placed upon the cheese cured at different temperatures, both by our own expert and also by the commercial judges.

In this low-temperature-cured cheese the flavor was remarkably mild but clean, and was free from all trace of bitterness or other taint. The texture was fine and silky and the body close.

(7) *Keeping quality.*—The keeping quality of the cold-cured cheese far excels that of the cheese ripened at higher temperatures. The better types of cheese cured at 40° F. are at present writing (eight months) still in their prime, while the 60° cheese has long since greatly deteriorated.

(8) *Effect of paraffin on quality.*—Portions of two lots of cheese were paraffined as they came from the press, but were otherwise handled the same as the unparaffined cheese. The results obtained showed that paraffining did not prejudicially affect their quality at any temperature. As paraffining greatly reduced the shrinkage, the beneficial effect of the system is obvious. The rapid introduction of the method in commercial practice further attests its value.

(9) The production of a thoroughly broken-down Cheddar cheese of mild, delicate flavor and perfect texture meets a demand which is impossible to satisfy with cheese cured at high temperatures. Without any question, if the general market can be supplied with this mild, well-ripened cheese, consumption will be greatly stimulated, not only by increasing the amount used by present consumers, but by largely extending the use of this valuable and nutritious article of food.

(10) The improvement in quality of cold-cured cheese, the enhanced keeping quality, and the material saving in shrinkage due to lessened evaporation are sufficient to warrant a considerable expenditure on the part of cheese producers in installing cold-curing stations.

The principle of increasing cost of equipment to lessen cost of production or augment gross earnings is recognized as a sound financial method by all large enterprises, and, while the expense involved is considerably more than is incurred under existing conditions, yet the advantages enumerated more than compensate for such expense where carried out under proper conditions.

(11) This system is particularly applicable where the product of a number of factories can be handled at one point, and such consolidated curing stations must be established before the cold-curing process can be economically introduced. Such stations are now successfully used in a number of localities. The greatest advantage will undoubtedly accrue from the use of this system of curing with summer-made cheese, but the process is equally applicable to cheese made at any season of the year.

APPENDIX.

ı the following appendix are given the original data collected in series of examinations made by Mr. Baer and the commercial erts. From these data are compiled the summaries which are ;ented in the text of the foregoing bulletin.

lts of examinations by Mr. Baer during progress of curing cheese in type I (firm, export Cheddar type).

LOT 1.—THOS. JOHNSTON, BOAZ, RICHLAND COUNTY, WIS.

'E.—The following observations were made by Mr. Baer upon receipt of the cheese at cold-curing n: Flavor, clean but low; body, close; texture, curdy but meaty; curd particles well cemented; straight, even; cheese, well made.

ng ıer- re.	Age of cheese when examined.	Numerical scores.			Descriptive scores.			Commercial value (standard, 13 cents).
		Flavor (standard, 45).	Texture (standard, 30).	Color (standard, 15).	Flavor.	Texture and body.	Color.	
	Months.							
	1	35	24	15	Flat, low ...	Curdy	O. K	.....
	2	37	27	14	Flat	Curdy	Streaked ...	9
....	3	40	29	14	Clean, low..	Smooth....	Wavy.....	10.5
	5	42	29	15	Clean.....	Stiff	O. K.....	12.5
	8	45	29	15	Clean, high.	Stiff, close.	O. K.....	13
	1	38	22	15	Low	Stiff	O. K.....	.....
	2	40	24	15	Low	Stiff	O. K.....	10.5
....	3	42	28	15	Low	Waxy	O. K.....	12.5
	5	38	29	15	Tainted	Loose.....	O. K.....	11.5
	1	38	24	15	Flat	Stiff	O. K.....	.....
	2	43	25	15	Flat	Stiff	O. K.....	11.5
....	3	44	29.5	15	Clean.....	Silky	O. K.....	13
	5	36	27	15	Off.....	Loose.....	O. K.....	10.5

LOT 2.—H. J. NOYES, MUSCODA, GRANT COUNTY, WIS.

'E.—The following observations were made by Mr. Baer upon receipt of the cheese at cold-curation: Flavor, clean; body, close, meaty; texture, smooth; color, bright, straight, natural amber; particles firmly cemented; not so dry and firm as lot 1.

	Months.							
	1	35	20	15	Flat, low ...	Curdy	O. K	.....
	2	37	21	15	Flat	Curdy	O. K	10
....	3	41	26.5	15	Clean.....	Smooth....	O. K	11.75
	5	45	30	15	Clean, high.	Silky	O. K	13.25
	8	45	30	15	Clean, high.	Silky	O. K	13.25
	1	35	21	15	Low	Curdy	Dull	.....
	2	35	22	15	Low	Curdy	Dull	10
....	3	42	27	14	Clean.....	Mealy	Dull	12
	5	44	30	15	Clean, high.	Silky	O. K	13
	1	35	20	14	Low	Curdy	Dull	.....
	2	38	25	15	Low	Curdy	Dull	.....
....	3	44	29.5	15	Clean, high.	Smooth....	O K	13
	5	44	29	15	Clean, high.	Silky	O K	13

Results of examinations by Mr. Baer during progress of curing cheese in type I (firm, export Cheddar type)—Continued.

LOT 3.—P. H. KASPER, NICHOLSON, WAUPACA COUNTY, WIS.

NOTE.—The following observations were made by Mr. Baer upon receipt of the cheese at cold-curing station: Flavor, high and clean; body, close and meaty; texture, smooth and silky; color, a splendid light amber, clear and straight; boxed and packed in excellent shape; cheese arrived in splendid condition; neatly bandaged and perfectly made; the finest cheese placed in storage.

Curing temperature.	Age of cheese when examined.	Numerical scores.			Descriptive scores.			Commercial value (standard, 13 cents).
		Flavor (standard, 45).	Texture (standard, 30).	Color (standard, 15).	Flavor.	Texture and body.	Color.	
	Months.							
40° F.	2	40	26	15	Clean.....	Smooth.....	O. K	12
	3	45	30	15	Clean.....	Silky	O. K	13
	5	45	30	15	Clean.....	Silky	O. K	13.25
	8	45	29	15	Clean, high.	Close, meaty.	O. K	13
50° F.	1	.....	.....	.....	Clean.....	Curdy	O. K	.....
	2	43	28	15	Clean.....	Smooth.....	O. K	12.5
	3	45	30	15	Clean.....	Silky	O. K	13
	5	44	30	15	Clean.....	Silky	O. K	13
60° F.	1	42	27	15	Clean.....	Smooth.....	O. K	12
	2	45	30	15	Clean.....	Smooth.....	O. K	13
	3	43	28	15	Clean.....	Loose.....	O. K	12
	5	43	29	14	Clean.....	Silky	O. K	12.75

LOT 4.—LA CROSSE CHEESE AND BUTTER CO., LA CROSSE, LA CROSSE COUNTY, WIS.

NOTE.—The following observations were made by Mr. Baer upon receipt of the cheese at cold-curing station: Flavor, not clean; body, close meaty; color, O. K.; cheese well made; the only fault found with this goods was the objectionable flavor, resembling that resulting from frozen feed.

20-pound daisies.

	Months.							
40° F.	1	30	23	12	Tainted.....	Curdy	O. K	.....
	2	34	26	12	Tainted.....	Waxy	O. K	9
	3	40	29	14	Tainted.....	Waxy	Wavy.....	12
	5	40	28	13	Low	Close	Wavy.....	11.75
	8	40	28	14	Off, flat.....	Fair	Wavy.....	11.75
50° F.	1	30	24	12	Tainted.....	Curdy	O. K	.....
	2	35	27	12	Tainted.....	Stiff	O. K	9
	3	40	29	14	Tainted.....	Waxy	O. K	12
	5	38	27	13	Tainted.....	Waxy	Mottled ..	10.5
60° F.	1	28	26	13	Tainted.....	Curdy	O. K	.....
	2	30	27	14	Tainted.....	Waxy	O. K	9
	3	38	29	14	Tainted.....	Smooth.....	O. K	11.5
	5	35	25	10	Tainted.....	Gassy.....	Faded	9.5

ults of examinations by Mr. Baer during progress of curing cheese in type I (firm, export Cheddar type)—Continued.

LOT 5.—LA CROSSE CHEESE AND BUTTER CO., LA CROSSE, WIS.

TE.—The following observations were made by Mr. Baer upon receipt of the cheese at cold-curing on: Flavor, clean but low; texture, good; color, O. K.; cheese well made and of fine quality.

10-pound prints.

ring iper- ure.	Age of cheese when examined.	Numerical scores.			Descriptive scores.			Commercial value (standard, 13 cents).
		Flavor (standard, 45).	Texture (standard, 30).	Color (standard, 15).	Flavor.	Texture and body.	Color.	
	Months.							
	1	38	22	15	Clean.....	Curdy	O. K.....	.....
	2	38	25	15	Clean.....	Curdy	O. K.....	10
?.....	3	43	27	15	Clean.....	Waxy	O. K.....	12
	8	42	27	15	Not clean...	Mealy	O. K.....	12
	1	38	24	15	Clean.....	Curdy	O. K.....	.....
?.....	2	41	26	15	Clean.....	Curdy	O. K.....	10.5
	3	43	27	15	Clean.....	Smooth....	O. K.....	12.75
	1	40	25	15	Clean.....	Curdy	O. K.....	.....
?.....	2	42	27	15	Clean.....	Smooth....	O. K.....	12.75
	3	44.5	29.5	15	Clean, high.	Smooth....	O. K.....	13

LOT 6.—LA CROSSE CHEESE AND BUTTER CO., LA CROSSE, WIS.

TE.—The following observations were made by Mr. Baer upon receipt of the cheese at cold-curing on: Flavor, not clean; body, close, meaty; color, O. K.; cheese well made, put up in neat, attractive

20-pound paraffined daisies.

	Months.							
	1	.....	.....	.....	Low	Curdy	O. K.....	.....
	2	30	22	15	Low	Curdy	O. K.....	9
?.....	3	43.5	29.5	15	Clean.....	Waxy	O. K.....	13
	5	40	29	14	Low	Waxy	O. K.....	12
	8	40	29	12	Off.....	Waxy,open	Mottled ...	11.75
	1	.....	.....	.....	Low	Curdy	O. K.....	.....
	2	33	23	15	Low	Curdy	O. K.....	10
?.....	3	41	28	15	Tainted	Smooth....	O. K.....	12.25
	5	39	28	14	Low	Waxy	O. K.....	12
	1	30	22	15	Low	Curdy	O. K.....	9
	2	33	26	15	Tainted	Salvy.....	O. K.....	10.5
?.....	3	38	27	15	Tainted	Salvy.....	O. K.....	11.5
	5	38	28	13	Tainted	Waxy	O. K.....	11.5

LOT 7.—LA CROSSE CHEESE AND BUTTER CO., LA CROSSE, WIS.

TE.—The following observations were made by Mr. Baer upon receipt of the cheese at cold-curing on: Flavor, clean but low; body, close, meaty; color, O. K.; cheese of very fine quality.

10-pound paraffined prints.

	Months.							
	1	38	22	15	Clean.....	Curdy	O. K.....	.....
?.....	2	38	25	15	Clean.....	Curdy	O. K.....	10
	8	42	28	15	Not clean, high.	Mealy	O. K.....	12.25
	1	38	24	15	Clean.....	Mealy	O. K.....	.....
?.....	2	41	26	15	Clean.....	Mealy	O. K.....	10.5
	1	40	25	15	Clean.....	Mealy	O. K.....	.....
?.....	2	43	28	15	Clean.....	Stiff	O. K.....	12.75

Results of examinations by Mr. Baer during progress of curing cheese in type II (sweet-curd type).

LOT 1.—E. G. HODGES, UNION, IOWA.

NOTE.—The following observations were made by Mr. Baer upon receipt of the cheese at cold-curing station: Flavor, clean but low; sweet, insipid taste; body, slightly loose; texture crumbly; color, O. K.; very small Swiss holes.

Curing temperature.	Age of cheese when examined.	Numerical scores.			Descriptive scores.			Commercial value (standard 13 cents).
		Flavor (standard 45).	Texture (standard 30).	Color (standard 15).	Flavor.	Texture and body.	Color.	
	Months.							
40° F.	1	.....	.....	.....	Flat	Curdy	Wavy	.....
	2	40	24	14	Flat	Waxy	Wavy	10.5
	3	43	29	14	Low	Clean	Wavy	12.5
	5	41	27	14	Flat	Loose	Wavy	11.5
50° F.	1	.....	.....	.....	Flat	Curdy	Wavy	.....
	2	38	25	13	Flat	Waxy	Wavy	10.5
	3	43	27	13	Low	Open	Wavy	12.5
	5	40	27	14	Low	Loose	Wavy	11
60° F.	1	35	22	12	Low	Curdy	Wavy	9.5
	2	36	24	12	Flat	Waxy	Wavy	10
	3	40	27	12	Low	Open	Wavy	11.5

LOT 2.—J. B. GILBERT & CO., STERLING, ILL.

NOTE.—The following observations were made by Mr. Baer upon receipt of the cheese at cold curing station: Flavor, clean but low; body, slightly loose; small Swiss holes; made soft and moist.

	Months.							
40° F.	1	.....	.....	.....	Low	Pasty	O. K	.....
	2	35	23	15	Low	Pasty	O. K	9.5
	3	38	25	15	Low	Loose	O. K	10
	5	37	25	14	Flat	Pasty	O. K	10.5
50° F.	1	.....	.....	.....	Low	Pasty	O. K	.....
	2	38	25	15	Low	Pasty	O. K	10
	3	38	25	15	Low	Pasty	O. K	10
	5	36	25	14	Low	Pasty	O. K	10.5
60° F.	1	35	22	15	Low	Pasty	O. K	9.5
	2	37	22	15	Low	Pasty	O. K	9.5
	3	40	20	15	Low	Open	O. K	10
	5	35	25	14	Low	Pasty	O. K	10.5

ults of examinations by Mr. Baer during progress of curing cheese in type III (soft, home-trade type).

LOT 1.—A. H. BARBER & CO., MERRILL, MICH.

TE.—The following observations were made by Mr. Baer upon receipt of the cheese at cold-curing on: Flavor, fair; body, loose, open; slightly huffed; color, O. K.; slightly open under the bandage; highly acid; packages poor.

ring perature.	Age of cheese when examined.	Numerical scores.			Descriptive scores.			Commercial value (standard 13 cents).
		Flavor (standard 45).	Texture (standard 30).	Color (standard 15).	Flavor.	Texture and body.	Color.	
	Months.							
	1	.....	.....	.....	.....	Mealy, acid	O. K	.....
F	2	30	21	14	.....	.....	.....	9.5
	3	35	24	14	Acidy	Sticky	O. K	11
	5	35	25	10	Sour	Mealy	Cut	9
	1	.....	.....	.....	Acidy	Mealy	O. K	.....
F	2	30	23	14	Acidy	Mealy	O. K	9.5
	3	35	26	14	Acidy	Pasty	O. K	11
	5	32	23	10	Sour	Mealy	Cut	8
	1	31	22	12	Acidy	Mealy	O. K	8
F	2	35	25	12	Acidy	Mealy	O. K	10
	3	38	22	14	Acidy	Pasty	O. K	11
	5	35	25	10	Sour	Mealy	Cut	9

LOT 2.—A. H. BARBER & CO., MERRILL, MICH.

TE.—The following observations were made by Mr. Baer upon receipt of the cheese at colding station: Flavor, fair; body, loose, open; slightly huffed; color, O. K.; packages, poor; cheese ed to mold.

	Months.							
F	3	40	27	12	Acidy	Pasty	Cut	11
	5	38	24	11	Acidy	Tallowy ...	Cut	11
F	3	41	28	12	Acidy	Salvy	Cut	11.5
	5	37	25	11	Acidy	Tallowy ...	Cut	10.5
F	3	41	28	12	Acidy	Salvy	Cut	11.5
	5	35	27	11	Acidy	Tallowy ...	Cut	10.5

LOT 3.—A. H. BARBER & CO., MERRILL, MICH.

YTE.—The following observations were made by Mr. Baer upon receipt of the cheese at colding station: Flavor, low but clean; body, slightly loose; texture curdy and short; cheese was soft; ved excess of moisture on the end surfaces; too highly acid; boxes badly broken and cheese dy.

	Months.							
	1	.....	.....	.....	Acidy	Mealy	O. K	.....
F.....	2	33	22	14	Acidy	Mealy	O. K	9
	3	38	25	14	Acidy	Tallowy ...	Wavy	10
	5	38	27	12	Acidy	Loose	Cut	11
	1	.....	.....	.....	Acidy	Mealy	O. K	.....
F.....	2	38	23	14	Acidy	Mealy	O. K	10
	3	40	25	14	Low	Tallowy ...	O. K	11
	5	37	26	10	Acidy	Loose	Cut	10.5
	1	.....	.....	.....	Not clean...	Mealy	O. K	.....
F.....	2	38	23	14	Not clean...	Mealy	O. K	10
	3	40	28	14	Low	Salvy	O. K	11.5
	5	35	25	10	Acidy	Loose	Cut	10

Results of examinations by Mr. Baer during progress of curing cheese in type III (soft, home-trade type)—Continued.

LOT 4.—A. H. BARBER & CO., MERRILL, MICH.

NOTE.—The following observations were made by Mr. Baer upon receipt of the cheese at cold-curing station: Flavor, low but clean; body, loose; texture, short; cheese was soft; showed excess of moisture on rinds; boxes badly broken; cheese quite moldy.

Curing temperature.	Age of cheese when examined.	Numerical scores.			Descriptive scores.			Commercial value (standard 13 cents).
		Flavor (standard 45).	Texture (standard 30).	Color (standard 15).	Flavor.	Texture and body.	Color.	
	Months.							
40° F.	1	.....	.....	.....	Acidy	Short	Wavy	.....
	2	35	22	14	Acidy	Curdy	Wavy	9.5
	3	43	29	14	Low	Waxy	Wavy	12.75
	5	40	27	12	Low	Loose	Cut	10.75
50° F.	1	.....	.....	.....	Acidy	Short	Wavy	.....
	2	38	22	13	Acidy	Short	Wavy	11
	3	43	26	13	Flat	Short	Wavy	12
	5	42	26	12	Clean	Loose	Cut	11.75
60° F.	1	35	24	13	Acidy	Short	Wavy	10
	2	38	22	13	Acidy	Short	Wavy	11.5
	3	42	26	12	Flat	Short	Wavy	12
	5	38	25	12	Sour	Loose	Cut	10.5

SCORES BY INDIVIDUAL JUDGES AT THE COMMERCIAL TEST MADE AT FIRST AND SECOND JURY TRIALS.

Type I (firm export Cheddar type).

LOT 1.—THOS. JOHNSTON, BOAZ, RICHLAND COUNTY, WIS.

First jury trial (cheese 3 months old).

Curing temperature.	Judges.	Numerical scores.			Descriptive scores.			Price (standard, 13 cents).
		Flavor (standard 45).	Texture (standard 30).	Color (standard 15).	Flavor.	Texture.	Color.	
40° F.	White	43	28.5	13.5	Clean....	Waxy ..	Specks..	12
	Kirkpatrick	41	27	12	Low	Salvy...	Mottled.	12.75
	Millar	40	22	10	Clean....	Pasty...	Mottled.	12.25
	Average	41.3	25.8	11.8	.....	.....	.....	12.33
50° F.	White	45	29	15	Perfect ..	Silky ...	O. K	12.5
	Kirkpatrick	44	28	14	Clean....	Waxy ..	O. K	12.5
	Millar	41	26	14	Clean....	Waxy ..	O. K	12.75
	Average	43.3	27.6	14.3	.....	.....	.....	12.58
60° F.	White	43	29	14	Clean....	Smooth.	O. K	12.25
	Kirkpatrick	42	29	14	Tainted .	Silky ...	O. K	12
	Millar	42	28	14	Clean....	Smooth.	O. K	13
	Average	42.3	28.6	14	.....	.....	.....	12.41

SCORES BY INDIVIDUAL JUDGES AT THE COMMERCIAL TEST MADE AT FIRST AND SECOND JURY TRIALS—Continued.

Type I (firm export Cheddar type)—Continued.

LOT 1.—THOS. JOHNSTON, BOAZ, RICHLAND COUNTY, WIS.

Second jury trial (cheese 5 months old).

Curing temperature.	Judges.	Numerical scores.			Descriptive scores.			Price (standard, 13 cents).
		Flavor (standard 45).	Texture (standard 30).	Color (standard 15).	Flavor.	Texture.	Color.	
40° F.	White	44	29	15	Clean	Waxy	O. K.	12.75
	Millar	43	28	15	Flat	Loose	O. K.	12.75
	Average	43.5	28.5	15				12.75
50° F.	White	40	29	15	Bitter	Smooth.	O. K.	12.5
	Millar	40	28	15	Bitter	Loose	O. K.	12.5
	Average	40	28.5	15				12.5
60° F.	White	39	29	15	Off	Smooth.	O. K.	12.5
	Millar	38	28	15	Off	Smooth.	O. K.	12.25
	Average	38.5	28.5	15				12.375

LOT 2.—P. H. KASPER, NICHOLSON, WAUPACA COUNTY, WIS.

First jury trial (cheese 3 months old).

40° F.	White	44	29	14.5	Clean	Waxy	O. K.	12.75
	Kirkpatrick	45	29	15	Clean	Silky	O. K.	12.75
	Millar	43	28	15	Clean	Waxy	O. K.	12.75
	Average	44	28.6	14.8				12.75
50° F.	White	44	29.5	14.5	Clean	Silky	O. K.	12.75
	Kirkpatrick	45	28.5	14.5	Clean	Waxy	O. K.	12.5
	Millar	43	27	15	Clean	Loose	O. K.	12.75
	Average	44	28.3	14.6				12.6
60° F.	White	44	27	14.5	Clean	Loose	O. K.	12.5
	Kirkpatrick	43	27	14	Flat	Pasty	O. K.	12
	Millar	42	25	14	Flat	Salvy	O. K.	12.25
	Average	43	26.3	14.16				12.25

LOT 2.—P. H. KASPER, NICHOLSON, WAUPACA COUNTY, WIS.

Second jury trial (cheese 5 months old).

40° F.	White	44	29	15	Clean	Smooth.	O. K.	13
	Millar	38	27	15	Flat	Loose	O. K.	12.12
	Average	41	28	15				12.56
50° F.	White	43	29	15	Bitter	Smooth.	O. K.	13
	Millar	40	28	15	Clean	Smooth.	O. K.	12.25
	Average	41.5	28.5	15				12.62
60° F.	White	42	29	15	Sharp	Smooth.	O. K.	13
	Millar	42	28	15	Clean	Smooth.	O. K.	12.5
	Average	42	28.5	15				12.75

SCORES BY INDIVIDUAL JUDGES AT THE COMMERCIAL TEST MADE AT FIRST AND SECOND JURY TRIALS—Continued.

Type I (firm export Cheddar type)—Continued.

LOT 3.—H. J. NOYES, MUSCODA, GRANT COUNTY, WIS.

First jury trial (cheese 3 months old).

Curing temperature.	Judges.	Numerical scores.			Descriptive scores.			Price (standard, 13 cents).
		Flavor (standard 45).	Texture (standard 30).	Color (standard 15).	Flavor.	Texture.	Color.	
40° F.	White	42	28	15	Flat	Pasty	O. K.	12
	Kirkpatrick	44	27	15	Clean	Salvy	O. K.	12.25
	Millar	41	24	15	Flat	Salvy	O. K.	12.25
	Average	42.3	26.3	15				12.16
50° F.	White	44.5	29	15	Perfect	Silky	O. K.	12.75
	Kirkpatrick	45	28.5	15	Clean	Waxy	O. K.	12.5
	Millar	43	26	15	Clean	Waxy	O. K.	12.5
	Average	44.1	27.8	15				12.58
60° F.	White	43	28.5	15	Clean	Silky	O. K.	12.5
	Kirkpatrick	45	29	15	Clean	Silky	O. K.	12.5
	Millar	43	26	15	Clean	Silky	O. K.	12.5
	Average	43.6	27.8	15				12.5

LOT 3.—H. J. NOYES, MUSCODA, GRANT COUNTY, WIS.

Second jury trial (cheese 5 months old).

40° F.	White	44	29	15	Clean	Smooth.	O. K.	13
	Millar	44	30	15	Clean	Waxy	O. K.	[illegible]
	Average	44	29.5	15				[illegible]
50° F.	White	44	28	15	Clean	Smooth.	O. K.	[illegible]
	Millar	43	29	15	Clean	Waxy	O. K.	[illegible]
	Average	43.5	28.5	15				[illegible]
60° F.	White	44	29	15	Clean	Waxy	O. K.	[illegible]
	Millar	42	27	15	Clean	Loose	O. K.	[illegible]
	Average	43	28	15				[illegible]

LOT 4.—LA CROSSE CHEESE AND BUTTER CO., LA CROSSE, LA CROSSE COUNTY, WIS.

First jury trial (cheese 3 months old).

40° F.	White	44	29	14	Clean	Waxy	O. K.	[illegible]
	Kirkpatrick	44	29	15	Clean	Salvy	O. K.	[illegible]
	Millar	42	28	14	Tainted	Waxy	O. K.	[illegible]
	Average	43.3	28.6	14.3				[illegible]
50° F.	White	44	29	14	Clean	Waxy	O. K.	[illegible]
	Kirkpatrick	44	29	15	Clean	Waxy	O. K.	[illegible]
	Millar	41	27	14	Tainted	Salvy	O. K.	[illegible]
	Average	43	28.3	14.3				[illegible]
60° F.	White	43	28	14	Flat	Smooth.	O. K.	[illegible]
	Kirkpatrick	43	28	15	High	Silky	O. K.	[illegible]
	Millar	40	26	14	Tainted	Salvy	O. K.	[illegible]
	Average	42	27.3	14.3				[illegible]

SCORES BY INDIVIDUAL JUDGES AT THE COMMERCIAL TEST MADE AT FIRST AND SECOND JURY TRIALS—Continued.

Type I (firm export Cheddar type)—Continued.

LOT 4.—LA CROSSE CHEESE AND BUTTER CO., LA CROSSE, LA CROSSE COUNTY, WIS.

Daisies. Second jury trial (cheese 5 months old).

Curing temperature.	Judges.	Numerical scores.			Descriptive scores.			Price (standard, 13 cents).
		Flavor (standard 45).	Texture (standard 30).	Color (standard 15).	Flavor.	Texture.	Color.	
40° F.	White	40	28	13	Flat	Pasty	Wavy	12
	Millar	42	27	14	Flat	Loose	O. K.	12.25
	Average	41	27.5	13.5				12.12
50° F.	White	40	28	12	Flat	Salvy	Wavy	11.75
	Millar	40	25	13	Tainted	Salvy	Faded	12
	Average	40	26.5	12.5				11.87
60° F.	White	35	25	13	Off	Loose	Faded	11
	Millar	35	25	13	Tainted	Salvy	Faded	11
	Average	35	25	13				11

LOT 5.—LA CROSSE CHEESE AND BUTTER CO., LA CROSSE, LA CROSSE COUNTY, WIS.

First jury trial (cheese 3½ months old).

40° F.	White	44	28	14	Clean	Waxy	O. K.	12.5
	Kirkpatrick	43	28	15	Clean	Waxy	O. K.	12.5
	Millar	42	27	13.5	Clean	Waxy	Wavy	12.25
	Average	43	27.6	14.1				12.41
50° F.	White	43	28	14	Flat	Waxy	O. K.	12.5
	Kirkpatrick	44	28	15	Clean	Waxy	O. K.	12.5
	Millar	43	28	14	Clean, low	Smooth.	O. K.	12.5
	Average	43.3	28	14.3				12.5
60° F.	White	43	28	14	Flat	Smooth.	O. K.	12.5
	Kirkpatrick	43	29	15	Clean	Waxy	O. K.	12.5
	Millar	42	28	14	Clean	Smooth.	O. K.	12.5
	Average	42.6	28.6	14.3				12.5

LOT 6.—LA CROSSE CHEESE AND BUTTER CO., LA CROSSE, LA CROSSE COUNTY, WIS.

First jury trial (cheese 3 months old).

40° F.	White	44	29	14	Clean	Waxy	O. K.	12.75
	Kirkpatrick	44	29	15	Clean	Waxy	O. K.	12.75
	Millar	42	28	14.5	Tainted	Waxy	O. K.	12.5
	Average	43.3	28.6	14.53				12.6
50° F.	White	44	29	14	Clean	Smooth.	O. K.	12.75
	Kirkpatrick	44	29	15	Clean	Waxy	O. K.	12.75
	Millar	41	28	14.5	Tainted	Salvy	O. K.	12.5
	Average	43	28.6	14.5				12.6
60° F.	White	43	28	14	Flat	Smooth.	O. K.	12.5
	Kirkpatrick	41	28	15	Tainted	Pasty	O. K.	12
	Millar	40	27	14	Tainted	Salvy	O. K.	12.25
	Average	41.3	27.6	14.3				12.25

SCORES BY INDIVIDUAL JUDGES AT THE COMMERCIAL TEST MADE AT FIRST AND SECOND JURY TRIALS—Continued.

Type I (firm export Cheddar type)—Continued.

LOT 6.—LA CROSSE CHEESE AND BUTTER CO., LA CROSSE, LA CROSSE COUNTY, WIS.

Second jury trial (cheese 5 months old).

Curing temperature.	Judges.	Numerical scores.			Descriptive scores.			Price (standard, 13 cents).
		Flavor (standard 45).	Texture (standard 30).	Color (standard 15).	Flavor.	Texture.	Color.	
40° F	White	43	26	14	Flat	Smooth.	O. K.	12.5
	Millar	40	28	13	Low	Salvy	Wavy	12
	Average	41.5	27	13.5				12.25
50° F	White	42	26	12	Flat	Waxy	Specks	12
	Millar	39	27	13	Low	Salvy	Wavy	11.75
	Average	40.5	26.5	12.5				11.87
60° F	White	41	25	10	Flat	Smooth.	Wavy	11.75
	Millar	38	26	13	Low	Loose	Wavy	11.5
	Average	39.5	25.5	11.5				11.62

LOT 7.—LA CROSSE CHEESE AND BUTTER CO., LA CROSSE, LA CROSSE COUNTY, WIS.

First jury trial (cheese 5 months old).

40° F.	White	44	29	14	Clean.	Waxy	O. K.	12.75
	Kirkpatrick	43	28	15	Clean.	Waxy	O. K.	12.5
	Millar	43	28	14	Clean.	Smooth.	O. K.	12.75
	Average	43.3	28.3	14.3				12.6
50° F.	White	43	29	14	Flat	Smooth.	O. K.	12.75
	Kirkpatrick	44	28	15	Clean.	Waxy	O. K.	12.75
	Millar	43	29	14	Clean.	Waxy	O. K.	12.75
	Average	43.3	28.6	14.3				12.75
60° F.	White	44	29	14	Clean.	Waxy	O. K.	12.75
	Kirkpatrick	43	29	15	Clean.	Waxy	O. K.	12.5
	Millar	43	28	14	Clean.	Smooth.	O. K.	12.75
	Average	43.3	28.6	14.3				12.6

SCORES BY INDIVIDUAL JUDGES AT THE COMMERCIAL TEST MADE AT FIRST AND SECOND JURY TRIALS—Continued.

Type II (sweet-curd type).

LOT 1.—E. G. HODGES, UNION, IOWA.

First jury trial (cheese 3 months old).

Curing temperature.	Judges.	Numerical scores.			Descriptive scores.			Price (standard, 13 cents).
		Flavor (standard 45).	Texture (standard 30).	Color (standard 15).	Flavor.	Texture.	Color.	
40° F.	White	43	28	13	Flat	Stiff	Wavy	12.25
	Kirkpatrick	43	27	14	Clean	Waxy	O. K	12
	Millar	42	28	13	Clean	Waxy	O. K	12.5
	Average	42.6	27.6	13.6				12.25
50° F.	White	43	26	13	Flat	Waxy	Wavy	12
	Kirkpatrick	43	27	13	Clean	Waxy	Wavy	12
	Millar	42	27	13	Clean	Waxy	Wavy	12.5
	Average	42.6	26.6	13				12.16
60° F.	White	43	28	13	Flat	Stiff	Wavy	12.25
	Kirkpatrick	43	28	13.5	Clean	Waxy	Wavy	12.5
	Millar	42	28	13	Clean	Waxy	Wavy	12.5
	Average	42.6	28	13.16				12.4

LOT 1.—E. G. HODGES, UNION, IOWA.

Second jury trial (cheese 5 months old).

40° F.	White	43	25	12	Low	Mealy	Wavy	12
	Millar	40	27	14	Low	Salvy	Dull	12
	Average	41.5	26	13				12
50° F.	White	41	25	12	Off	Loose	Wavy	11.5
	Millar	38	25	14	Low	Weak	Dull	11.5
	Average	39.5	25	13				11.5

LOT 2.—J. B. GILBERT & CO., STERLING, ILL.

First jury trial (cheese 3 months old).

40° F.	White	39	25	14	Low	Pasty	O. K	11
	Kirkpatrick	42	27	15	Low	Loose	O. K	11.5
	Millar	41	25	14	Low	Pasty	O. K	11
	Average	40.6	25.6	14.3				11.16
50° F.	White	40	25	14	Low	Pasty	O. K	11
	Kirkpatrick	40	25	14	Low	Salvy	O. K	11.25
	Millar	40	25	14	Low	Pasty	O. K	11
	Average	40	25	14				11.08
60° F.	White	40	25	14	Flat	Pasty	O. K	11
	Kirkpatrick	41	26	14	Low	Pasty	O. K	11.25
	Millar	39	23	14	Low	Pasty	O. K	11
	Average	40	24.6	14				11.08

SCORES BY INDIVIDUAL JUDGES AT THE COMMERCIAL TEST MADE AT FIRST AND SECOND JURY TRIALS—Continued.

Type II (sweet-curd type)—Continued.

LOT 2.—J. B. GILBERT & CO., STERLING, ILL.

Second jury trial (cheese 5 months old).

Curing temperature.	Judges.	Numerical scores.			Descriptive scores.			Price (standard, 13 cents).
		Flavor (standard 45).	Texture (standard 30).	Color (standard 15).	Flavor.	Texture.	Color.	
40° F.	White	39	24	13	Low	Salvy	Wavy	11
	Millar	38	25	14	Low	Salvy	O. K	11
	Average	38.5	24.5	13.5				11
50° F.	White	39	25	13	Low	Pasty	Wavy	11.25
	Millar	39	26	14	Low	Loose	O. K	11
	Average	39	25.5	13.5				11.12
60° F.	White	38	24	13	Bitter	Salvy	Wavy	11
	Millar	40	26	14	Low	Loose	O. K	11
	Average	39	25	13.5				11

Type III (soft home-trade type).

LOT 1.—A. H. BARBER & CO., MERRILL, MICH.

First jury trial (cheese 5 months old).

Curing temperature.	Judges.	Numerical scores.			Descriptive scores.			Price (standard 13 cents).
		Flavor (standard 40).	Texture (standard 30).	Color (standard 15).	Flavor.	Texture.	Color.	
40° F.	White	38	25	13	Tainted	Salvy	O. K	11.75
	Kirkpatrick	41	28	13	Acidy	Pasty	O. K	12
	Millar	40	25	13	Tainted	Salvy	O. K	12
	Average	39.6	26	13				11.9
50° F.	White	38	25	13	Tainted	Salvy	O. K	11.75
	Kirkpatrick	43	29	13	Acidy	Pasty	O. K	12.5
	Millar	41	26	13	Tainted	Salvy	O. K	12.25
	Average	40.6	26.6	13				12.16
60° F.	White	40	26	13	Tainted	Salvy	O. K	12
	Kirkpatrick	42	27	13	Acidy	Waxy	O. K	12.25
	Millar	41	25	13	Low	Pasty	O. K	12.25
	Average	41	26	13				12.16

LOT 1.—A. H. BARBER & CO., MERRILL, MICH.

Second jury trial (cheese 5 months old).

40° F.	White	40	25	10	Off	Mealy	Cut	11.5
	Millar	32	27	12	Acidy	Pasty	Cut	11.75
	Average	36	26	11				11.62
50° F.	White	40	25	10	Tainted	Tallowy	Cut	11.5
	Millar	33	28	13	Acidy	Salvy	Cut	12
	Average	36.5	26.5	11.5				11.75
60° F.	White	39	25	10	Off	Tallowy	Cut	11.25
	Millar	35	28	12	Acidy	Pasty	Cut	12
	Average	37	26.5	11				11.62

SCORES BY INDIVIDUAL JUDGES AT THE COMMERCIAL TEST MADE AT FIRST AND SECOND JURY TRIALS—Continued.

Type III (soft home-trade type)—Continued.

LOT 2.—A. H. BARBER & CO., MERRILL, MICH.

First jury trial (cheese 3 months old).

Curing temperature.	Judges.	Numerical scores.			Descriptive scores.			Price (standard 13 cents).
		Flavor (standard 45.)	Texture (standard 30).	Color (standard 15).	Flavor.	Texture.	Color.	
40° F.	White	40	26	12	Acidy	Salvy	Wavy	11.5
	Kirkpatrick	42	28	12	Flat	Pasty	Wavy	11.5
	Millar	40	25	13	Acidy	Pasty	Mottled	12.25
	Average	40.6	26.3	12.5				11.75
50° F.	White	40	27	13	Acidy	Pasty	O. K	11.75
	Kirkpatrick	43	29	13	Clean	Waxy	O. K	12
	Millar	42	27	14	Acidy	Waxy	O. K	12.5
	Average	41.6	27.6	13.3				12.08
60° F.	White	40	27	12	Acidy	Pasty	Wavy	11.75
	Kirkpatrick	40	28	13	Tainted	Salvy	O. K	11.25
	Millar	40	25	13	Acidy	Tallowy	O. K	12
	Average	40	26.6	12.6				12

LOT 2.—A. H. BARBER & CO., MERRILL, MICH.

Second jury trial (cheese 5 months old).

40° F	White	38	25	10	Acidy	Tallowy	Cut	11
	Millar	42	27	12	Acidy	Tallowy	Cut	11
	Average	40	26	11				11
50° F	White	37	25	10	Acidy	Tallowy	Cut	11
	Millar	40	26	12	Acidy	Tallowy	Cut	11
	Average	38.5	25.5	11				11
60° F	White	37	24	10	Acidy	Tallowy	Cut	11
	Millar	38	27	12	Acidy	Tallowy	Cut	11
	Average	37.5	25.5	11				11

LOT 3.—A. H. BARBER & CO., MERRILL, MICH.

First jury trial (cheese 3 months old).

40° F.	White	40	27	12	Acidy	Close	Wavy	11
	Kirkpatrick	41	28	13	Acidy	Tallowy	Cut	11.5
	Millar	40	27	14	Acidy	Tallowy	O. K	11.5
	Average	40.3	27.3	13				11.3
50° F.	White	42	28	13	Low	Smooth.	Wavy	12
	Kirkpatrick	43	28	13	Clean	Tallowy	O. K	12
	Millar	42	28	14	Acidy	Smooth.	O. K	12
	Average	42.6	28	13.3				12
60° F.	White	40	27	12	Bitter	Salvy		11.5
	Kirkpatrick	42	27	13	Clean	Loose	O. K	11.75
	Millar	39	25	14	Acidy	Pasty	O. K	11.25
	Average	40.3	26.3	13				11.6

SCORES BY INDIVIDUAL JUDGES AT THE COMMERCIAL TEST MADE AT FIRST AND SECOND JURY TRIALS—Continued.

Type III (soft home-trade type)—Continued.

LOT 3.—A. H. BARBER & CO., MERRILL, MICH.

Second jury trial (cheese 5 months old).

Curing temperature.	Judges.	Numerical scores.			Descriptive scores.			Price (standard 13 cents)
		Flavor (standard 45).	Texture (standard 30).	Color (standard 15).	Flavor.	Texture.	Color.	
40° F.	White	40	26	14	Tainted	Smooth	O. K	11.5
	Millar	36	28	12	Tainted	Loose	O. K	11
	Average	38	27	13				11.25
50° F.	White	39	25	10	Tainted	Smooth	Wavy	11.25
	Millar	40	26	12	Tainted	Loose	O. K	11.5
	Average	39.5	25.5	11				11.37
60° F.	White	39	25	13	Tainted	Smooth	Specks	11.5
	Millar	38	27	12	Tainted	Loose	O. K	11.25
	Average	38.5	26	12.5				11.37

LOT 4.—A. H. BARBER & CO., MERRILL, MICH.

First jury trial (cheese 5 months old).

40° F	White	42	27	13	Flat	Stiff	Wavy	12
	Kirkpatrick	42	29	14	Clean	Waxy	O. K	12.5
	Millar	42	28	14	Low	Waxy	O. K	12.5
	Average	42	28	13.6				12.3
50° F	White	40	25	13	Flat	Mealy	Wavy	11.25
	Kirkpatrick	42	29	13	Clean	Pasty	O. K	12
	Millar	41	26	12	Low	Pasty	Wavy	12
	Average	41	26.6	12.6				11.75
60° F	White	41	26	12	Flat	Mealy	Cut	11.5
	Kirkpatrick	43	28	13	Clean	Mealy	Wavy	12.25
	Millar	42	27	13	Flat	Pasty	Wavy	12.25
	Average	42	27	12.6				12

LOT 4.—A. H. BARBER & CO., MERRILL, MICH.

Second jury trial (cheese 5 months old).

40° F	White	43	26	10	Flat	Mealy	Cut	12.25
	Millar	43	28	14	Clean	Smooth	Cut	12.25
	Average	43	27	12				12.25
50° F	White	43	27	11	Flat	Smooth	Cut	12.5
	Millar	42	28	14	Flat	Smooth	Cut	12
	Average	42.5	27.5	12.5				12.25
60° F	White	41	25	9	Flat	Mealy	Wavy	11.75
	Millar	40	25	13	Acidy	Pasty	Cut	11.75
	Average	40.5	25	11				11.75

EASTERN EXPERIMENTS, 1902–03.

Conducted by L. L. VAN SLYKE, G. A. SMITH, and E. B. HART,
Of the New York Agricultural Experiment Station.

SUMMARY.

(1) *Object of experiment.*—The investigation was undertaken by the United States Department of Agriculture in cooperation with this station, its object being to study, on a commercial scale under commercial conditions, the influence of different temperatures upon the cheese during the curing process.

(2) *Plan of experiment.*—Cheese was secured which represented the product of the States of New York, Pennsylvania, and Ohio, and placed in cold storage at the temperatures of 40°, 50°, and 60° F. These were examined commercially by a committee of experts when first placed in cold storage, and later after being in cold storage ten, twenty, twenty-eight, and thirty-five weeks. Cheeses of different sizes were used, weighing 70, 65, 45, 35, and 12½ pounds. Also, in one case, cheeses were covered with a coating of paraffin. Chemical analyses were made at intervals.

(3) *Loss of weight.*—The loss of weight increased with increase of temperature, being on an average in twenty weeks 3.8 pounds per 100 pounds of cheese at 40° F., 4.8 pounds at 50° F., and 7.8 pounds at 60° F. The large-sized cheeses lost less weight per 100 pounds than those of smaller size.

(4) *Results of scoring cheese.*—Cheese cured at 40° F. was superior in quality to the same kind cured at higher temperatures. That cured at 50° F. was superior in quality to that cured at 60° F. The general averages of the scores at the end of twenty weeks were as follows: 95.7 at 40° F., 94.2 at 50° F., and 91.7 at 60° F. The difference in quality was confined in most cases to flavor and texture, the color and finish being little or not at all affected in cheese that was in good condition at the beginning.

(5) *Effects of covering cheese with paraffin.*—The commercial qualities of cheese were favorably influenced after six months in the case of that covered with paraffin, especially in flavor. The loss of moisture was greatly lessened, amounting only to a fraction of a pound for 100 pounds of cheese at 40° F. and 50° F., and being only about one-fifth the average loss found at 60° F. with cheese not so treated. The cheeses were also perfectly clean and free from mold, while all the cheeses not treated with paraffin were covered with mold.

(6) *Results of chemical analysis.*—The amount of certain water-soluble nitrogen compounds in cheese, such as caseoses, peptones, amides, and ammonia, is used as a means for measuring chemically the degree of ripeness in cheese. The amount of water-soluble nitrogen compounds increases with the age of cheese and with the temperature at which the cheese is cured.

(7) *Some practical applications.*—Curing cheese at low temperatures increases the amount of cheese to sell by preventing loss of moisture, and covering cheese with paraffin increases still more the yield of marketable cheese. This saving amounts to several dollars a ton. Also, the improved quality of cheese cured at low temperatures gives such cheese a higher market price.

REPORT OF RESULTS OF CURING CHEESE IN COLD STORAGE.

INTRODUCTION.

On the part of the New York Agricultural Experiment Station at Geneva, the work of selecting cheese, sampling, and supervision was performed by George A. Smith, dairy expert, and L. L. Van Slyke, chemist of the station; E. B. Hart assisted in the chemical work. The New York Mercantile Exchange was requested to designate competent persons to judge the cheese upon a commercial basis, and, the subject being referred to the cheese committee of the exchange, the following members were named as trade experts for this service: C. S. Martin, representing the oldest and largest cheese house in New York; F. B. Swift, representing one of the largest cheese-exporting firms in Montreal and New York, and D. W. Whitmore, head of a well-known firm. On the part of the Department of Agriculture, B. F. Van Valkenburgh, dairy inspector, gave immediate personal supervision.

The cheese was cured in New York City and examined and scored there, from time to time, without removal from cold storage.

The plan of the experiment was to secure cheese representing the States of New York, Pennsylvania, and Ohio, to place this in cold storage at different temperatures, to have commercial examinations made from time to time by a committee of chosen experts, to weigh the cheese at intervals, and to make chemical analyses of it. The object of this work was to study during the curing process the effect of different temperatures and the effect of covering cheese with paraffin upon (1) the commercial quality of the cheese, (2) the loss of weight, and (3) the chemical changes taking place.

DESCRIPTION OF SOURCES AND CHARACTER OF DIFFERENT LOTS OF CHEESE USED IN THE EXPERIMENT.

The arrangements for carrying on the experiment were not completed until the latter part of September, when it was somewhat difficult to secure large-sized cheeses, because most of the factories were

making only the small home-trade size. We were able, however, to get the makers in two cases to make the large-sized cheeses for this special work, but they were not of the best quality in every respect.

Lot I comprised 21 cheeses, averaging 64 pounds in weight, made by A. B. Hargrave at Heuvelton, St. Lawrence County, N. Y. These were made from the mixed milk of September 26, which contained 3.8 per cent of fat. The milk was ripened to 4½ spaces by the Marschall rennet test at a temperature of 86° F. Rennet extract was used at the rate of 2½ ounces for 1,000 pounds of milk. The milk began to thicken in fifteen minutes. The curd was heated to 98° F. in forty-five minutes. One hour and twenty minutes later the curd showed one-eighth of an inch of fine threads by the hot-iron test, when the whey was removed. The curd was then packed, drained, and kept for three hours, after which it was milled, salted at the rate of 2 pounds for 1,000 pounds of milk, cooled to 80° F., and put in press.

This lot of cheese was shipped to New York on September 30 and placed in cold storage on October 6.

Lot II comprised 40 boxes of cheese, made by J. E. Case at Turtlepoint, Pa., during the third week in September. They averaged 45 pounds in weight. It was found impossible to get a special lot of cheese made in Pennsylvania for this work, and so it was decided to take some already made. These cheeses were therefore older when put into cold storage, and did not get the full benefit of ripening at lower temperatures. In making the cheese, a starter of lactic ferment was used and the milk ripened to about 5 spaces by the Marschall test at a temperature of 86° F. Rennet extract was used at the rate of 2½ ounces for 1,000 pounds of milk, and the curd was cut in about forty-five minutes. The subsequent heating was carried to about 100° F. The whey was removed as soon as the curd strung on a hot iron. After milling, the curd was allowed to stand about half an hour before salting, with frequent stirring, and then cooled to 90° F. Salt was added at the rate of 2½ pounds for 1,000 pounds of milk used.

This lot of cheese was placed in cold storage on October 6.

Lot III consisted of 44 cheeses, averaging in weight about 34 pounds. They were made by J. H. Searl at Lowville, Lewis County, N. Y., from the mixed night and morning milk of September 26. Half were uncolored (A) and half were colored (B). The milk contained 4 per cent of fat and 12.6 per cent of solids. The milk was ripened to 3½ spaces by the Marschall test at 84° F. Rennet extract was used at the rate of 2½ ounces for 1,000 pounds of milk. The curd was cut in twenty-five minutes, and fifteen minutes later heat was applied, the temperature of 98° F. being reached in fifty minutes. Forty minutes later the whey was removed, as the curd showed one-eighth of an inch of string by the hot-iron test. After packing and draining in the usual way the curd was milled about four hours after the removal of whey. Salt was added at the rate of 2 pounds for 1,000 pounds of milk used, and the curd was cooled to 80° F. and then put in press.

This lot of cheese was shipped to New York October 1 and placed in cold storage October 7.

Lot IV consisted of two different sizes of cheeses, made by C. S. Alger at Martinsburg, Lewis County, N. Y. There were 20 colored cheeses (A), each weighing about 65 pounds, and 28 cheeses of so-called Stilton size or style (B), each weighing about 12½ pounds. (These are ordinarily known in market as "Young Americas.") The cheese was made from mixed milk of September 29, containing 4 per cent of fat and 12.6 per cent of solids. The conditions of manufacture were normal.

This lot of cheese was shipped on October 3 and placed in cold storage October 8.

Lot V comprised 34 cheeses, made by E. S. Rice at Triumph, Ohio, each averaging in weight about 36½ pounds. Rennet extract was added at the rate of 3 ounces for 1,000 pounds of milk at 86° F. The curd was cut in thirty minutes and then heated to 104° F. in about thirty minutes, the whey being drawn an hour and a half later. Salt was added at rate of 2¼ pounds for 1,000 pounds of milk used.

This lot was shipped October 7 and placed in cold storage October 13, 1902.

Lot VI consisted of 40 cheeses, each cheese weighing about 70 pounds. It was not at first intended to include a comparative trial between cheese in natural form and coated with paraffin (according to the increasing commercial practice), and no cheese was purchased by the Department of Agriculture for this purpose. But at the request of the New York Agricultural Experiment Station, and through the liberal cooperation of Messrs. Martin & Co., this was accomplished. Martin & Co. furnished this lot of cheese at their own expense and risk, but they were added to the five purchased lots, divided among the three curing rooms, as later recorded, and subjected to the same conditions and examinations as the rest. The cheese contained in this lot represented two different dates of manufacture one week apart October 10 (A) and October 17 (B).

This lot of cheese was made by H. Petrie at Turin, Lewis County, N. Y. The milk, of good quality in every respect, was warmed to 86° F. and a carefully prepared sour-milk starter added. It was then ripened to about 4 spaces by the Marschall test. Rennet extract was added at the rate of 2½ ounces for 1,000 pounds of milk. In twenty-five to thirty minutes the curd was cut, the cutting being somewhat fine, after which careful stirring was begun and continued until the pieces of curd were well separated and beginning to shrink. Heat was then applied, the temperature of 98° F. being reached in about forty-five minutes. Stirring was continued until the curd strung on the hot iron one-eighth of an inch, when the whey was removed. The curd was then matted, cut into pieces about 3 by 6 by 6 inches, and turned at intervals of six or eight minutes until the curd was well drained and solid. The curd was then piled until it acquired a smooth, velvety feeling, after which it was milled, spread out, stirred, and cooled until fat

started from it when squeezed in the hand. It was then salted at the rate of 2 pounds for 1,000 pounds of milk used, and finally put in press. Light pressure was applied at first—just enough to make the curd hold together in the form of the mold. At the end of one hour the cheeses were removed from the hoops, the cloths and outside of the cheeses rinsed with warm water, replaced in press, and pressure applied for eighteen hours.

This lot was placed in cold storage October 24, half of the number being covered with paraffin (Ap and Bp) and half being in natural condition (An and Bn).

LENGTH OF EXPERIMENT.

In February the cheese stored at 60° F. was removed and sold. In April the cheese stored at 50° F. was placed on the market, and also most of the cheese kept at 40° F. Some of the cheese that had been held at 40° F. was retained and kept until June 1, when it was sold, except some that was kept and placed at a temperature of 32° F. for further work.

DISTRIBUTION OF CHEESES IN COLD STORAGE.

Arrangements were made with the Merchants' Refrigerating Company of New York City to provide special rooms and take care of these different lots of cheese. Rooms were provided in which the temperatures could be controlled and kept at 40° F., 50° F., and 60° F. Automatic records were arranged in each room, showing the condition of the temperature continuously. The regulation of temperatures was remarkably well done; the variations from the desired point, for the entire period of storage, did not exceed 2° for the 60° room or 1° for the other rooms. It was an exceptionally good piece of work in maintaining even temperatures for thirty or forty successive weeks.

The different lots of cheese were distributed in the different temperatures in the manner indicated by the following table:

Distribution of cheese at different temperatures.

Lot.		Number and weight of cheeses at 40° F.		Number and weight of cheeses at 50° F.		Number and weight of cheeses at 60° F.	
		Number.	*Pounds.*	*Number.*	*Pounds.*	*Number.*	*Pounds.*
I		10	645	6	384	5	325
II		18	811	12	535	10	448
III	White	11	378	6	207	5	170
	Colored	11	371	6	204	5	171
IV	Large	9	585	6	387	5	329
	Stiltons	16	197	8	99	4	50
V		19	696	8	290	7	256
VI	An	5	358	3	211	2	143
	Ap	5	356	3	212	2	142
	Bn	5	352				
	Bp	5	358	3	208	2	138

LOSS OF WEIGHT.

The following table gives the weights of the cheese kept at the different temperatures and the percentages of loss at the several dates stated:

Weights of cheese and percentages of loss at different temperatures.

Lot and description.	Date of weighing.	Room at 40° F.		Room at 50° F.		Room at 60° F.	
		Weight.	Loss.	Weight.	Loss.	Weight.	Loss.
		Pounds.	*Per cent.*	*Pounds.*	*Per cent.*	*Pounds.*	*Per cent.*
I (New York export Cheddars)	Oct. 6	645	.....	394	.....	325	.....
	Feb. 13	616	4.5	367	4.4	306	6.8
	Apr. 10	611	5.3	361	6.0	.....	.....
	June 1	600	7.0	.....	.....	.....	.....
II (Pennsylvania Cheddars)	Oct. 7	811	.....	535	.....	468	.....
	Feb. 13	789	2.7	515	3.7	436	5.1
	Apr. 10	769	3.5	511	4.5	.....	.....
	June 1	774	4.5	.....	.....	.....	.....
III A (white)	Oct. 7	378	.....	207	.....	180	.....
	Feb. 13	362	4.2	195	5.8	155	8.8
	Apr. 10	357	5.6	192	7.2	.....	.....
	June 1	371	.....	204	.....	171	.....
III B (colored)	Feb. 13	360	3.0	193	5.4	157	8.2
	Apr. 10	355	4.3	189	7.4	.....	.....
	June 1	348	6.2	.....	.....	.....	.....
IV A (large)	Oct. 8	585	.....	337	.....	329	.....
	Feb. 13	559	4.4	336	5.4	305	7.3
	Apr. 10	554	5.3	365	5.7	.....	.....
	June 1	545	6.8	.....	.....	.....	.....
IV B (Stiltons, or Young Americas)	Oct. 8	197	.....	99	.....	50	.....
	Feb. 13	188	4.6	91	8.1	44	12.0
	Apr. 10	184	6.6	88	11.1	.....	.....
	June 1	179	9.1	.....	.....	.....	.....
V (Ohio flats)	Oct. 13	696	.....	290	.....	356	.....
	Feb. 13	664	4.6	271	6.6	233	9.0
	Apr. 10	658	5.5	266	8.3	.....	.....
	June 1	646	7.2	.....	.....	.....	.....
VI An (Export Cheddars, without paraffin)	Oct. 24	358	.....	211	.....	143	.....
	Feb. 13	349	2.5	206	2.4	137	4.2
	Apr. 10	346.7	3.1	202.7	4.0	.....	.....
	June 1	342	4.5	.....	.....	.....	.....
VI Ap (Same, paraffined)	Oct. 24	356	.....	212	.....	142	.....
	Feb. 13	355	0.3	211	0.5	140	1.4
	Apr. 10	354	0.6	210	0.9	.....	.....
	June 1	352.8	0.9	.....	.....	.....	.....
VI Bn (New York Cheddars, without paraffin)	Oct. 24	352	.....	.....	.....	.....	.....
	Feb. 13	340	3.4	.....	.....	.....	.....
	Apr. 10	336.5	4.4	.....	.....	.....	.....
	June 1	333.2	5.3	.....	.....	.....	.....
VI Bp (Same, paraffined)	Oct. 24	358	.....	208	.....	138	.....
	Feb. 13	357	0.3	207	0.5	136	1.5
	Apr. 10	356.6	0.4	207	0.5	.....	.....
	June 1	355.4	0.7	.....	.....	.....	.....

Showing weight lost by cheese.

Lot.	Average weight of each cheese.	Age when placed in cold storage.	Age when weighed.	Amount lost for 100 pounds of cheese—		
				At 40° F.	At 50° F.	At 60° F.
	Pounds.	*Days.*	*Weeks.*	*Pounds.*	*Pounds.*	*Pounds.*
I	64	9	20	4.5	4.4	6.8
I	64	9	28	5.3	6.0	.....
I	64	9	35	7.0	.....	.....
II	45	18	20	2.7	3.7	5.1
II	45	18	28	3.5	4.5	.....
II	45	18	35	4.5	.....	.....
III A	34	9	20	4.2	5.8	8.8
III A	34	9	28	5.6	7.2	.....
III B	34	9	20	3.0	5.4	8.2
III B	34	9	28	4.3	7.4	.....
III B	34	9	35	6.2	.....	.....
IV A	65	8	20	4.4	5.4	7.3
IV A	65	8	28	5.3	5.7	.....
IV A	65	8	35	6.8	.....	.....
IV B	12.5	8	20	4.6	8.1	12.0
IV B	12.5	8	28	6.6	11.1	.....
IV B	12.5	8	35	9.1	.....	.....
V	36.5	.....	19	4.6	6.6	9.0
V	36.5	.....	27	5.5	8.3	.....
V	36.5	.....	34	7.2	.....	.....
VI An	70	7	17	2.5	2.4	4.2
VI An	70	7	25	3.1	4.0	.....
VI An	70	7	32	4.5	.....	.....
VI Ap	70	7	17	0.3	0.5	1.4
VI Ap	70	7	25	0.6	0.9	.....
VI Ap	70	7	32	0.9	.....	.....
VI Bn	70	14	17	3.4	.....	.....
VI Bn	70	14	25	4.4	.....	.....
VI Bn	70	14	32	5.3	.....	.....
VI Bp	70	14	17	0.3	0.5	1.5
VI Bp	70	14	25	0.4	0.5	.....
VI Bp	70	14	32	0.7	.....	.....

From the data contained in the above table, we are enabled to make the following statements:

(1) The cheese continued to lose water in nearly every case as long as weighings were made. This was true of all temperatures.

(2) The loss of weight was least at 40° F. and increased with increase of temperature. At the end of twenty weeks the cheese in temperature 40° F. had lost on an average 3.8 pounds per 100; that in 50° F., 4.8 pounds; and that in 60° F., 7.8 pounds. The loss at temperature 40° F. was 1 pound less than at 50° F., and 4 pounds less than at 60° F. In other words, the loss at 60° F., as compared with the loss at 50° F., was three times as great as was the loss at 50° F., compared with the loss at 40° F. The loss of weight was proportionally greater at higher temperatures.

(3) If we determine the average weekly loss from the data given in this table, we find that during the first twenty weeks the loss was at the average rate of 3 ounces a week at 40° F., 3.8 ounces at 50° F., and 6.2 ounces at 60° F. From the twentieth to the twenty-eighth week the average weekly loss was 2.2 ounces at 40° F. and 3.2 ounces at 50° F. The cheese kept at 40° F. appeared to lose more moisture per week from April 10 to June 1 than previously.

(4) The size of cheese influences the loss of moisture. Small cheeses, other conditions being the same, lose a larger proportion of moisture in curing than do large cheeses, owing to the greater amount of surface relative to weight in the smaller cheeses. This tendency is shown by the following tabulated statement:

Weight lost per 100 pounds of cheese in twenty weeks.

Average weight of cheese.	At 40° F.	At 50° F.	At 60° F.
Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
70	2.5	2.4	4.2
45	2.7	3.7	5.1
35	3.9	5.9	8.5
12½	4.6	8.1	12.0

It will be noticed that the variation is much less at 40° than at the higher temperature.

(5) The method of covering cheese with paraffin greatly reduces the loss of moisture. In VI An and Bn the cheeses were in natural condition, while in VI Ap and Bp they were covered with paraffin, being dipped in melted paraffin when a few days old. The loss of moisture in cheese covered with paraffin was only 0.3 pound per 100 pounds of cheese in twenty weeks at 40° F., 0.5 pound at 50° F., and 1.4 pounds at 60° F. In the same kind of cheese not thus covered the loss of moisture was much greater at all temperatures. By covering cheese with paraffin a saving in loss of moisture can be effected amounting to 5 or 6 pounds per 100 pounds of cheese at 60° F., and at 50° or below the total loss of moisture can be reduced to less than 1 pound per 100 pounds of cheese. In addition, the use of paraffin prevents the growth of molds. In every case cheeses covered with paraffin were entirely clean, while the others were more or less heavily coated with molds.

RESULTS OF COMMERCIAL EXAMINATION OF CHEESE.

Arrangements were made to have the cheese examined at intervals by the commercial experts already named, who were to score the cheeses separately, the basis of a perfect cheese being 50 for flavor, 25 for texture, 15 for color, and 10 for finish. We give the average of the scores in the following table:

Results of scoring of cheese.

Lot.	Date of examination.	Temperature of curing room.	Flavor.	Texture.	Color.	Finish.	Total score.	Remarks.
		°F.						
	Oct. 6, 1902	.....	48	24	15	10	97	
	Dec. 15, 1902	40	48	24	15	10	97	
	.....do.....	50	46.5	23	15	10	94.5	
	.....do.....	60	46	22	15	10	93	
	Feb. 13, 1903	40	46.7	23.3	15	10	95	
	.....do.....	50	44.3	23	14.7	10	92	
.....	.....do.....	60	42.7	22	14.3	10	89	
	Apr. 10, 1903	40	46.3	23	14.7	10	94	Flavor not perfectly clean.
	.....do.....	50	44.7	22.7	14.6	10	92	Flavor somewhat tainted.
	June 1, 1903	40	48	24.7	15	10	97.7	Clean flavor and silky texture.
	Oct. 6, 1902	.....	48	24	15	10	97	
	Dec. 15, 1902	40	48	23.5	15	10	96.5	
	.....do.....	50	48	23	15	10	96	
	.....do.....	60	47	22.5	15	10	94.5	
	Feb. 13, 1903	40	46	22	15	10	93	
I.....	.....do.....	50	45	22	15	10	92	
	.....do.....	60	44	22	15	10	91	
	Apr. 10, 1903	40	45.7	22.3	15	10	93	Flavor not perfectly clean.
	.....do.....	50	43.7	22.3	14.7	10	90.7	Flavor tainted.
	June 1, 1903	40	46	23	15	10	94	Flavor flat; texture smooth and silky.
	Oct. 7, 1902	.....	48	24	15	10	97	
	Dec. 15, 1902	40	48.5	24	15	10	97.5	
	.....do.....	50	48	24	15	10	97	
	.....do.....	60	46.5	33	15	10	94.5	
	Feb. 13, 1903	40	47.7	23.7	15	10	96.4	Flavor clean; texture wax-like.
II.....	.....do.....	50	47.7	24	15	10	96.7	
	.....do.....	60	45.3	23.3	14.8	10	94.4	
	Apr. 10, 1903	40	47.7	24	15	10	96.7	
	.....do.....	50	46.7	23.7	15	10	95.4	Flavor slightly bitter.
	June 1, 1903	40	47	24	15	10	96	Flavor clean; texture smooth and silky.
	Oct. 8, 1902	.....	47	23	14	10	94	Rather acid and of imperfect color.
	Dec. 15, 1902	40	47.5	23.5	14	10	95	
	.....do.....	50	46.5	22.5	13.5	10	92.5	
	.....do.....	60	44.5	22	13.5	10	90	
	Feb. 13, 1903	40	44.7	22.7	13.3	10	90.7	
	.....do.....	50	42.3	22	12.3	10	86.6	
	.....do.....	60	41.7	21.3	12	10	85	
V A.....	Apr. 10, 1903	40	46	23	14.7	10	93.7	Flavor acid; texture stiff.
	.....do.....	50	43.3	22	13	10	88.3	Flavor acid and not clean; texture harsh; color imperfect.
	June 1, 1903	40	46	23	12.7	10	91.7	Flavor clean texture smooth and silky; color light.

Results of scoring of cheese—Continued.

Lot.	Date of examination.	Temperature of curing room.	Flavor.	Texture.	Color.	Finish.	Total score.	Remarks.
		°F.						
	Oct. 8, 1902	.....	48	23	15	10	96	
	Dec. 15, 1902	40	48	23.5	15	10	96.5	
	.....do.....	50	47.5	23.5	15	10	96	
	.....do.....	60	46.5	22.5	15	10	94	
	Feb. 13, 1903	40	47.3	23.7	15	10	96	
IV B.....	.....do.....	50	45	22	15	10	92	
	.....do.....	60	44	22	15	10	91	
	Apr. 10, 1903	40	46.3	24.3	15	10	95.6	
	.....do.....	50	46.3	24	14.7	10	95	
	June 1, 1903	40	46.7	23.3	15	10	95	Flavor clean; textu wax-like.
	Oct. 13, 1902	.....	46	23	15	10	94	
	Dec. 15, 1902	40	46.5	23.5	15	10	95	
	....do.....	50	45	22.5	15	10	92.5	
	....do.....	60	40.5	20.5	15	10	86	
	Feb. 13, 1903	40	45.3	21.3	14.7	10	91.7	
	....do.....	50	43.7	20.3	14.7	10	88.7	
V.....	....do.....	60	43	20	14.7	10	87.7	
	Apr. 10, 1903	40	45.3	22	14.7	10	92	Flavor and textu imperfect.
	....do.....	50	44	21.7	14.3	10	90	Slightly bitter and weak texture.
	June 1, 1903	40	46	22.7	15	10	93.7	Flavor clean; textu smooth and pasty.
	Dec. 15, 1902	40	49	24	15	10	98	
	....do.....	50	48.5	23.5	15	10	97	
	....do.....	60	48	23.5	15	10	96.5	
	Feb. 13, 1903	40	48	24	15	10	97	
	....do.....	50	48	24	15	10	97	
VI. An...	....do.....	60	45.3	23	15	10	93.3	
	Apr. 10, 1903	40	48	24	15	10	97	
	....do.....	50	48	24	15	10	97	
	June 1, 1903	40	47.7	24.3	15	10	97	Surface covered w mold.
	Feb. 13, 1903	40	48	24	15	10	97	
	....do.....	50	48	24	15	10	97	
	....do.....	60	46.3	23.3	15	10	94.3	
	Apr. 10, 1903	40	48.3	24	15	10	97.3	
VI. Ap...	....do.....	50	48	24	15	10	97	
	June 1, 1903	40	48.7	24.3	15	10	98	Condition practica perfect; surfa bright and clear.
	Feb. 13, 1903	40	48	24	15	10	97	
	....do.....	50	48	24	15	10	97	
	....do.....	60	44.7	22.7	14.3	10	91.7	
VI. Bn...	Apr. 10, 1903	40	48	24	15	10	97	
	....do.....	50	47	24	15	10	96	
	June 1, 1903	40	47.7	24.3	15	10	97	Surface covered w mold.
	Feb. 13, 1903	40	48	24	15	10	97	
	....do.....	50	48	24	15	10	97	
	....do.....	60	45.7	23	15	10	93.7	
VI. Bp...	Apr. 10, 1903	40	48	24	15	10	97	
	....do.....	50	47	24	15	10	96	
	June 1, 1903	40	48.7	24.3	15	10	98	Condition practical perfect; surfa bright and clear.

SUMMARY.

From the data embodied in the preceding table, we are able to present the following statements as a summary of the results:

(1) Almost without exception the cheese cured at lower temperatures was superior in quality to that cured at higher temperatures. Cheese cured at 40° F. usually scored higher than that cured at 50° F., and the cheese cured at 50° F. scored higher in every instance than that cured at 60° F. Averaging all our results, we have the following general scores for the different temperatures: At 40° F., 95.7; at 50° F., 94.2; at 60° F., 91.7. From these figures we see that the cheese deteriorated considerably more at 60° F. as compared with 50° F. than it did at 50° F. as compared with 40° F. The difference of scores is 1.5 in favor of 40° F., as compared with 50° F., and 2.5 in favor of 50° F. as compared with 60° F. In other words, the higher the temperature the greater is the relative deterioration of cheese in quality for each degree of temperature.

(2) The difference in quality fell mostly on the flavor and texture. Averaging all the figures, we have the following results:

Averages of flavor and texture.

Qualities.	At 40° F.	At 50° F.	At 60° F.
Flavor	47.4	46.4	44.8
Texture	23.4	23	22.2

Here also we see that the difference is greater between 60° and 50° F. than between 50° and 40° F. in the direction of poorer quality.

(3) At any given time the cheese cured at 40° F. was usually better in quality than that at 50°, and that at 50° was better than that at 60°. The longer the time of curing the greater was the difference in favor of the lower temperatures. The following tabulated averages of the results illustrate the statements:

Averages for different ages.

Age of cheese.	Score at 40° F.	Score at 50° F.	Score at 60° F.
Weeks.			
10	96.3	94.7	92
20	93.8	91.5	89.7
28	94.2	91.9	.....
35	95.3	.....	.....

The cheese cured at 60° showed such deterioration in quality at the end of twenty weeks that it was sold. While the cheese cured at 40° and 50° showed some deterioration in quality at twenty weeks, it scored higher at twenty-eight weeks than at twenty weeks. The cheese kept at 40° showed its highest score at thirty-five weeks in several cases

The higher score was always in favor of the lower temperature by several points.

(4) The effect of covering cheese with paraffin was in several cases to improve the quality as compared with cheese not so covered. The difference was more marked at 60° than at lower temperatures. The cheese covered with paraffin and cured at 40° showed its highest score at the end of thirty-five weeks.

Results of use of paraffin.

Character of cheese.	Age in weeks.	At 40° F.	At 50° F.	At 60° F.
Cheese, normal (An)	20	97	97	93.3
Cheese, normal (Bn)	20	97	97	91.7
Cheese covered with paraffin (Ap)	20	97	97	94.3
Cheese covered with paraffin (Bp)	20	97	97	93.7
Cheese, normal (An)	28	97	97	.....
Cheese, normal (Bn)	28	97	96	.....
Cheese covered with paraffin (Ap)	28	97.3	97	.....
Cheese covered with paraffin (Bp)	28	97	96	.....
Cheese, normal (An and Bn)	35	97	.....	.....
Cheese covered with paraffin (Ap and Bp)	35	98	.....	.....

RESULTS OF CHEMICAL ANALYSIS OF CHEESE.

The analytical data upon which the following discussion of chemical results is based were obtained by the methods described in Bulletin No. 215 of the New York Agricultural Experiment Station, and the table giving these data in full may be found in Bulletin No. 234 of the same series. But in this work the paranuclein, caseoses, and peptones were not separated from one another, their combined amount being obtained by difference.

(1) *The process of cheese ripening.*—When cheese ripens, the most prominent change taking place is in the nitrogen compounds. The casein of milk is changed by the action of rennet enzyme into curd, chemically known as paracasein. In the process of cheese making, lactic acid is formed and this unites with the paracasein, forming a compound known as paracasein monolactate.[a] It is this compound that imparts to cheese curd the property of forming fine strings on a hot iron, and it is the formation of this paracasein monolactate that accounts for the changes in appearance, plasticity, and texture of cheese curd during the process of cheddaring. However, there is reason to believe that the changes that take place in the process of cheese-ripening start with and are dependent upon the presence of paracasein monolactate or some similar compound. Hence, from a chemical point of view, cheese ripening consists mainly of the change of paracasein monolactate into other forms of nitrogen compounds, chief among which in the order of their formation are paranuclein, caseoses, peptones, amido compounds, and ammonia. These com-

[a] Bull. No. 214, N. Y. Agricultural Experiment Station.

pounds, formed from paracasein monolactate, are readily soluble in water, while paracasein monolactate is not. Hence, in ripened cheese we have larger amounts of substances that are soluble and smaller amounts of substances that are insoluble. Ripened cheese is for this reason believed to be more readily digestible than green cheese. The amount of soluble nitrogen compounds is used as a measure of the extent of cheese ripening.

This present investigation offers an opportunity for studying the chemical results of cheese ripening under different conditions of temperature and with a number of different types of Cheddar cheese under commercial conditions.

(2) *Moisture in cheese.*—Before taking up a study of the nitrogen compounds of the cheese under investigation we will call attention to the amount of moisture in the cheese.

In the case of lots I, II, III, and IV, in which the moisture was determined when the cheese was placed in cold storage, the moisture content was found to vary from 34.20 to 35.44 per cent; this may be regarded as a comparatively small variation. In lots IV and V the moisture must have been above 40 per cent at the time the cheese was placed in cold storage, because ten weeks later, when the first analysis was made, the moisture was about 39 per cent. The result of moisture determination shows a gradual decrease in moisture as the cheese becomes older, as indicated by the following averages:

Per cent of moisture in cheese.

	At 40° F.	At 50° F.	At 60° F.
When put in cold storage	36.50	36.50	36.50
After being in storage ten weeks	36.30	35.70	35.65
After being in storage twenty weeks	35.35	34.66	34.26

The decrease of moisture is greater with increase of temperature, a point which has been dwelt upon in connection with loss of weight.

(3) *Amount of paracasein monolactate in cheese.*—The amount of paracasein monolactate formed in the different cheeses when one and two weeks old varied from 40.70 to 66.14 per cent of the nitrogen in the cheese and averaged 57.49 per cent. The amount decreased as the cheese aged, and more rapidly at higher than at lower temperatures, as shown by the following general averages:

Percentage of nitrogen in cheese in form of paracasein monolactate.

Age of cheese.	At 40° F.	At 50° F.	At 60° F.
1 week	57.49	57.49	57.49
10 weeks	47.94	42.08	37.09
20 weeks	47.10	35.24	30.77
28 weeks	40.54	31.82	.....
35 weeks	36.36	.....	.....

This diminution of paracasein monolactate is undoubtedly due to its conversion into water-soluble nitrogen compounds.

(4) *Amount of water-soluble nitrogen compounds in cheese.*—While the amount of water-soluble compounds of nitrogen in cheese is not a guide in respect to the detailed chemical changes taking place in ripening cheese, it serves as a general indication of the extent and rapidity of those changes. The data below, representing averages of our results, show that the amount of water-soluble nitrogen increases with increase of temperature and with lapse of time:

Percentage of nitrogen in cheese in form of water-soluble compounds.

Age of cheese.	At 40° F.	At 50° F.	At 60° F.
1 week	14.55	14.55	14.55
10 weeks	20.03	25.18	28.48
20 weeks	24.12	31.56	36.24
28 weeks	26.27	33.00	.....
35 weeks	27.64	.....	.....

(5) *Amount of amido compounds in cheese.*—The amido compounds of cheese are of interest because it is possible that among these compounds we are to look for the substance or substances responsible for cheese flavors. Little or no cheese flavor appears in cheese until amido compounds are formed. The amount of amido compounds increases with temperature and with lapse of time, as shown by the following averages:

Percentage of nitrogen in cheese in form of amido compounds.

Age of cheese.	At 40° F.	At 50° F.	At 60° F.
1 week	4.06	4.06	4.06
10 weeks	6.92	8.98	9.85
20 weeks	5.53	8.95	13.30
28 weeks	7.60	12.70	.....
35 weeks	9.00	.....	.....

(6) *Amount of ammonia in cheese.*—The formation of ammonia compounds in cheese may possibly be associated also with the development of cheese flavor. No ammonia is found in fresh cheese. It begins to be formed in appreciable quantities in about four weeks and increases with the age of the cheese. Its amount is greater at higher than at lower temperatures. The following averages give a good idea of the amount found in cheese under the conditions indicated:

Percentage of nitrogen in cheese in form of ammonia.

Age of cheese.	At 40° F.	At 50° F.	At 60° F.
1 week	0	0	0
10 weeks	1.20	1.87	1.97
20 weeks	1.62	3.44	3.36
28 weeks	2.52	3.48	.....

SOME PRACTICAL APPLICATIONS.

From the data presented in the foregoing pages, we have seen that the use of low temperatures in curing cheese shows two prominent results—(1) reduction of loss of weight and (2) improvement of commercial quality. Any reduction in loss of weight or any improvement in quality means an increase in the amount of money that can be realized in the sale of the cheese. It is a matter of practical interest and importance to consider in detail what specific increased or decreased market values were found for the cheese under the different conditions of experiment.

ECONOMY IN REDUCING LOSS OF MOISTURE.

We have seen that the loss of moisture in curing cheese can be reduced by using a lower temperature, or by covering cheese with a thin coating of paraffin, or by a combination of these two conditions.

Increased amount of cheese resulting from using low temperatures.—Taking the longest period of time for which we were able to compare the results at the different temperatures employed (twenty weeks), it was found that the cheese cured at 40° F. had lost, on an average, 3.8 pounds for 100 pounds of cheese; the cheese at 50° F. had lost 4.8 pounds, and that at 60° F. 7.8 pounds. For 100 pounds of cheese originally placed in the curing rooms at the different temperatures, we had for sale at the end of twenty weeks 96.2 pounds of cheese cured at 40° F., 95.2 pounds cured at 50° F., and 92.2 pounds cured at 60° F.

Assuming that the cheese sells at a uniform price of 10 cents a pound, there would be receipts from the original 100 pounds of each of the different cheeses as follows:

Cheese cured at 40° F	$9.62
Cheese cured at 50° F	9.52
Cheese cured at 60° F	9.22

Under these conditions, the receipts from the cheese kept at 40° F. are 10 cents per 100 pounds more than for that kept at 50° F. and 40 cents per 100 pounds more than that kept at 60° F. As will be pointed out later, the differences are really greater than this.

Increased amount of cheese resulting from covering cheese with a coating of paraffin.—At the end of seventeen weeks, cheese covered with

paraffin had lost only 0.3 pound for 100 pounds of cheese originally placed in storage at 40° F., 0.5 pound at 50° F., and 1.4 pounds at 60° F. The saving thus effected, based on the uniform price of cheese at 10 cents a pound, would average about 35 cents for 100 pounds of cheese cured at 40° F., 43 cents for 100 pounds at 50° F., and 64 cents for 100 pounds at 60° F.; or, comparing cheese kept at 40° F., covered with paraffin, with cheese kept at 60° F. not so covered, there would be a difference of about 75 cents per 100 pounds in favor of the paraffined cheese.

The cost of covering cheese with paraffin is slight. Conveniences for the work can be obtained from manufacturers of dairy supplies.

Increased value resulting from improvement in quality of cheese cured at low temperatures.—We have already studied the results of the scores furnished by the experts who examined the cheese from time to time. They were requested also to place upon the different lots of cheese a commercial valuation based upon the results of their scoring. Below we present these commercial valuations in tabulated form. The experts properly disregarded the actual market rates, which have fluctuations sometimes difficult to account for, and established as their constant basis of valuation 13 cents per pound for cheese scoring over 95 points.

Value of one pound of cheese.

Date of examination.	Temperature curing room.	Lot I.	Lot II.	Lot III.	Lot IV.		Lot V.	Lot VI.			
					A.	B.		An.	Ap.	Bn.	Bp.
	° F.	Cents.	Cents.	Cents.	Cents.	Cents.	Cents.	Cents.	Cents.	Cents.	Cents.
Dec. 15, 1902	40	13	13	13	13	13	13	13.75	13.75	13.75	13.75
Do	50	12.75	13	13	12.50	13	12.50	13.75	13.75	13.75	13.75
Do	60	12.50	12.75	12.75	12	12.75	11.75	13.75	13.75	13.75	13.75
Feb. 13, 1903	40	13	12.50	13	12	13	12.25	14.25	14.25	14.25	14.25
Do	50	12.25	12.25	13	11.75	12.25	12	14.25	14.25	14.25	14.25
Do	60	12	12.25	12.50	11.75	12.25	11.75	13.50	13.75	13.25	13.50
Apr. 9, 1903	40	12.75	12.50	13	12.50	13	12.50	14.75	14.75	14.75	14.75
Do	50	12.25	12.25	13	12	13	12.25	14.50	14.75	14.50	14.75
June 1, 1903	40	.....	.....	.....	.....	.....	.....	14.50	14.50	14.75	14.75

In studying the data embodied in this table, the following points are noticeable:

(1) In the case of lots I to V, the value of the cheese cured at 40° F. was greater in most cases than that cured at 50° F., and in every case greater than that cured at 60° F. In most cases, the cheese cured at 50° F. had a higher value than that cured at 60° F. These statements hold good for the twenty weeks during which the cheeses were kept at the three different temperatures. If the cheese cured at 60° F. had been kept for a longer period, it would have shown serious decrease in value.

In the case of lot VI, the value was the same for all temperatures on December 15, when the cheese was about eight weeks old. And this lot was of so much better quality that it was assigned a value above the 13-cent basis, in proportion to its score above 95 points. Two months later, there was no difference at the temperature of 40° and 50° F., but the cheese kept at 60° had a lower value than the cheese kept at the lower temperatures. In April, when the cheese was about twenty-five weeks old, there was a little difference in favor of the lower temperatures.

(2) In comparing the cheese covered with paraffin (lot VI, Ap and Bp) with that left in natural condition (lot VI, An and Bn), there was no difference in their value during the first seventeen weeks at the temperatures 40° and 50° F. At 60° F., at the end of seventeen weeks, the cheese covered with paraffin was valued at a quarter of a cent a pound more than the unparaffined. When the cheese kept at 40° F. was twenty-five and thirty-two weeks old, there was no difference in value between the paraffined cheese and that not paraffined; but in the cheese kept at 50° F. there was, at the end of twenty-five weeks, an increased value of a quarter of a cent a pound in favor of the paraffined cheese. It thus appears that the results are more marked at higher temperatures than at lower temperatures in favor of the paraffined cheese, but even then only after the first few months of ripening. The chief value of paraffining cheese appears to be in preventing loss of moisture and in keeping the surface of the cheese free from molds.

(3) If we average the results obtained with the different lots of cheese, we have the following figures:

Value per pound of cheese cured at different temperatures.

Date of examination.	At 40° F.	At 50° F.	At 60° F.
	Cents.	*Cents.*	*Cents.*
Dec. 15, 1902	13.300	13.175	12.950
Feb. 13, 1903	13.275	13.050	12.675
Apr. 9, 1903	13.525	13.325	.....

At the end of ten weeks the cheese cured at 40° F. was worth 12½ cents more per 100 pounds than the cheese cured at 50° F. and 35 cents more than that cured at 60° F. The cheese cured at 50° F. was worth 22½ cents per 100 pounds more than that cured at 60° F.

At the end of twenty weeks the cheese cured at 40° F. was worth 22½ cents more per 100 pounds than the cheese cured at 50° F. and 60 cents more than that cured at 60° F., while that cured at 50° F. was worth 37½ cents per 100 pounds more than that cured at 60° F.

At the end of twenty-eight weeks the cheese cured at 40° F. was worth 20 cents more per 100 pounds than that cured at 50° F.

Increased receipts from cheese cured at low temperatures and covered with paraffin.—We have seen that the curing of cheese at low temper-

atures has the effect of (1) preventing loss of moisture and (2) increasing the value of the cheese. Therefore, we not only have more cheese to sell but can sell it at a higher price. Taking cheese twenty weeks old as a basis for comparison, we know how much weight is lost at different temperatures and also the difference in price. From these figures the following tabulated statement is given:

Money returns at several temperatures.

Temperature of curing.	Cured cheese equivalent to 100 pounds of green cheese.	Market price of 1 pound of cheese.	Receipts from cheese.
° F.	*Pounds.*	*Cents.*	*Dollars.*
40	96.2	13.275	12.77
50	95.2	13.050	12.42
60	92.2	12.675	11.69

These figures indicate that from 100 pounds of green cheese put into the curing room we were able to realize from that cured at 40° F. 35 cents more than from cheese cured at 50° F., and $1.08 more than from that cured at 60° F. From the cheese cured at 50° F. we received 73 cents more a hundred pounds than from that cured at 60° F.

If we compare our results obtained with cheese covered with paraffin with those given by cheese not so covered, we have the following tabulated statement:

Cured cheese equivalent to 100 pounds of green cheese and comparative value of that paraffined and unparaffined.

Temperature of curing room.	Cured cheese equivalent to 100 pounds of green cheese.		Value of 1 pound of cheese.		Receipts from cheese.	
	Paraffined.	Not paraffined.	Paraffined.	Not paraffined.	Paraffined.	Not paraffined.
° F.	*Pounds.*	*Pounds.*	*Cents.*	*Cents.*	*Dollars.*	*Dollars.*
40	99.7	96.2	14.25	14.25	14.21	13.70
50	99.5	95.2	14.25	14.25	14.19	13.56
60	98.6	92.2	13.75	13.50	13.56	12.45

At 40° F. the difference in favor of the paraffined cheese is 51 cents for 100 pounds of cheese originally placed in the curing room; at 50° F. the difference is 63 cents, and at 60° F., $1.11. Covering cheese with paraffin results in greater saving at higher temperatures than at lower temperatures.

Comparing paraffined cheese cured at 40° F. with unparaffined cheese cured at 60° F., we find a difference of $1.76 for 100 pounds of cheese in favor of the paraffined cheese and the lower temperature.

U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF ANIMAL INDUSTRY—BULLETIN NO. 50.

D. E. SALMON, D. V. M., Chief of Bureau.

GERMAN MEAT REGULATIONS.

WITH ORIGINAL TEXT.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1903.

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
Washington, D. C., July 15, 1903.

SIR: For the information of American packers and exporters the German meat-inspection law of June 3, 1900, was translated into English and published, in both German and English, by this Bureau, as Circular 32, and was reprinted on pages 523–534, Seventeenth Annual Report of the Bureau (for the year 1900).

Regulations and proclamations have been issued which have a direct bearing upon the law, and in response to requests the following official German documents of this nature are published herewith for the information of interested exporters.

This work has been translated by Miss Annette M. Dye, of this Bureau, under the direction of Dr. Ch. Wardell Stiles, zoologist in charge.

In order to obviate the appearance of giving an *interpretation* to these documents the translator has found it necessary to hold as closely as possible to a literal translation, taking into consideration those conditions in Germany which differ from certain conditions in America. Accordingly, English rhetoric has been made secondary to a rendering of the original German into English. Nevertheless, there are some words and expressions in the original which may not be entirely clear and the interpretation of which must rest with the German authorities.

D. E. SALMON,
Chief of Bureau.

Hon. JAMES WILSON,
Secretary of Agriculture.

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GERMAN MEAT REGULATIONS.

[TRANSLATION.]

PROCLAMATIONS OF THE SENATE.

PROCLAMATION

With regard to the ordinance concerning fees for the inspection of meat imported past the customs line, the meat-inspection customs ordinance, and the marking of inspected foreign meat.

The senate in the following again makes known to the public the ordinance resolved upon by the Bundesrath concerning fees for the inspection of meat imported past the customs line, the meat-inspection customs ordinance resolved upon by the Bundesrath, and the proclamation issued by the imperial chancellor (Reichskanzler) concerning the marking of inspected foreign meat.

Drawn up in the session of the senate, Hamburg, March 4, 1903.

PROCLAMATION.

With regard to the ordinance concerning fees for the inspection of meat imported past the customs line.

In accordance with the regulation in § 22, No. 3, of the law concerning the inspection of food animals and of meat of June 3, 1900 (Reichs-Gesetzbl., p. 547), the Bundesrath has resolved upon the following ordinance concerning fees:

Ordinance concerning fees

For the inspection of meat imported past the customs line.

§ 1.

For the inspection of meat imported past the customs line taking place in accordance with the law concerning the inspection of food animals and of meat of June 3, 1900 (Reichs-Gesetzbl., p. 547), fees are to be paid by the possessor of the meat according to the following regulations. These fees include especially also the compensations for the taking and sending of samples, for reports, entering in the inspection books, making out of certificates, marking of the meat, and any necessary travel of the experts.

GERMAN MEAT REGULATIONS.

[ORIGINAL.]

BEKANNTMACHUNGEN DES SENATS.

BEKANNTMACHUNG,

betreffend die Gebührenordnung für die Untersuchung des in das Zollinland eingehenden Fleisches, die Fleischbeschau-Zollordnung und die Kennzeichnung des untersuchten ausländischen Fleisches.

Der Senat bringt nachstehend die von dem Bundesrat beschlossene Gebührenordnung für die Untersuchung des in das Zollinland eingehenden Fleisches, die von dem Bundesrat beschlossene Fleischbeschau-Zollordnung und die von dem Reichskanzler erlassene Bekanntmachung, betreffend die Kennzeichnung des untersuchten ausländischen Fleisches, noch besonders zur öffentlichen Kenntnis.

Gegeben in der Versammlung des Senats, Hamburg, den 4. März 1903.

BEKANNTMACHUNG,

betreffend die Gebührenordnung für die Untersuchung des in das Zollinland eingehenden Fleisches.

Auf Grund der Bestimmung im § 22 Nr. 3 des Gesetzes, betreffend die Schlachtvieh- und Fleischbeschau, vom 3. Juni 1900 (Reichs-Gesetzbl., S. 547), hat der Bundesrat nachstehende Gebührenordnung beschlossen.

Gebührenordnung

für die Untersuchung des in das Zollinland eingehenden Fleisches.

§ 1.

Für die auf Grund des Gesetzes, betreffend die Schlachtvieh- und Fleischbeschau, vom 3. Juni 1900 (Reichs-Gesetzbl., S. 547), stattfindende Untersuchung des in das Zollinland eingehenden Fleisches sind von dem Besitzer des Fleisches Gebühren nach Massgabe der nachstehenden Bestimmungen zu entrichten. Diese Gebühren umfassen insbesondere auch die Vergütungen für die Entnahme und Versendung von Proben, für Benachrichtigungen, Eintragungen in die Beschaubücher, Ausstellung von Befundscheinen, Kennzeichnung des Fleisches und etwa notwendige Reisen der Sachverständigen.

§ 2.

The fees, irrespective of the fees established for special inspections in §§ 4 to 6, amount to—

A. In the case of *fresh* meat:

	Marks.
(1) For neat cattle (exclusive of calves) or for reindeer, per head	2.50
(2) For a calf	.75
(3) For a swine or wild boar	.75
(4) For a sheep or a goat	.60
(5) For a horse or some other animal of the soliped genus (ass, mule, hinny)	3.00

B. In the case of *prepared* meat (except fat):

(6) For casings, per kilogram	.010
(7) For bacon, per kilogram	.020
(8) For other prepared meat, per kilogram	.025

However, for casings at least 0.40 mark, for other prepared meat at least 0.50 mark, are to be collected for every shipment.

In the case of assorted shipments (§ 12, paragraph 3, of the regulations D, concerning the carrying out of the law), or when in the case of the condemnation of a sample [taken at random], the examination is carried out with reference to the ground of condemnation through the entire homogeneous shipment (§ 12, paragraph 4, of the regulations above referred to) the fees established under B, Nos. 6 to 8, are to be paid to double the amount.

Pfennig amounts [other than multiples of 5] in the final total are to be rounded out to the next higher number divisible by 5.

§ 3.

If the preparation of the meat for inspection (taking out of the viscera, detaching of the leaf fat, cutting of the swine into halves, hanging up or laying out [arranging] of the portions of flesh in the inspection room) is not made by the person having the right to receive [the wares] or provided for by him, for this work an additional amount of 20 per cent of the inspection fees established according to § 2 is to be collected. Pfennig amounts [other than multiples of 5] in the final total are to be rounded out to the next higher number divisible by 5.

§ 4.

The fees for the inspection for *trichina* amount to—

	Mark.
(1) For an entire swine or wild boar	1.00
(2) For meat, with the exception of bacon (e. g., ham, piece of pickled meat, and the like), per piece	.50
(3) For bacon, per piece	.35

For the assistance of the trichina inspector in inspection for measle worm [*Cysticercus*] special fees are not to be collected.

§ 2.

Die Gebühren betragen, abgesehen von den in den §§ 4 bis 6 für besondere Untersuchungen festgesetzten Gebühren,

A. bei frischem Fleische:

1)	für ein Stück Rindvieh (ausschliesslich der Kälber) oder ein Renntier	2,50 M.,
2)	für ein Kalb	0,75 "
3)	für ein Schwein oder Wildschwein	0,75 "
4)	für ein Schaf oder eine Ziege	0,60 "
5)	für ein Pferd oder ein anderes Tier des Einhufergeschlechts (Esel, Maultier, Maulesel)	3,00 "

B. bei zubereitetem Fleische (ausgenommen Fett):

6)	von Därmen für jedes Kilogramm	0,01 M.,
7)	von Speck für jedes Kilogramm	0,02 "
8)	von sonstigem zubereiteten Fleische für jedes Kilogramm	0,025 ".,

Jedoch sind von Därmen mindestens 0,40 M., von sonstigem zubereiteten Fleische mindestens 0,50 M. für jede Sendung zu erheben.

Bei nicht gleichartigen Sendungen (§ 12 Abs. 3 der Ausführungsbestimmungen D) oder wenn im Falle der Beanstandung einer Stichprobe die Untersuchung in bezug auf den Beanstandungsgrund an der ganzen gleichartigen Sendung ausgeführt wird (§ 12 Abs. 4 ebenda) sind die unter B Nr. 6 bis 8 festgesetzten Gebühren in doppelter Höhe zu entrichten.

Pfennigbeträge bei der Endsumme sind auf eine durch 5 teilbare Zahl nach oben abzurunden.

§ 3.

Erfolgt die Herrichtung des Fleisches für die Beschau (Herausnahme der Eingeweide, Loslösen der Liesen, Zerlegung der Schweine in Hälften, Aufhängen oder Auflegen der Fleischteile im Untersuchungsraume) nicht durch den Empfangsberechtigten oder eine von ihm zur Verfügung gestellte Hülfskraft, so wird für diese Arbeiten noch ein Zuschlag von 20 Prozent zu den nach Massgabe des § 2 festgesetzten Untersuchungsgebühren erhoben. Pfennigbeträge bei der Endsumme sind auf eine durch 5 teilbare Zahl nach oben abzurunden.

§ 4.

Die Gebühren für die Untersuchung auf Trichinen betragen:

1)	für ein ganzes Schwein oder Wildschwein	1,00 M.,
2)	für ein einzelnes Stück Fleisch, ausgenommen Speck (z. B. Schinken, Stück Pökelfleisch und dergleichen)	0,50 "
3)	für ein Stück Speck	0,35 ".

Für die Hülfeleistung der Trichinenschauer bei der Finnenschau sind besondere Gebühren nicht zu erheben.

§ 5.

Without prejudice to the fees collected according to § 6, the fees for the *chemical* examination of *prepared* meat, fat excepted, amount to 0.02 mark, for the *chemical* examination of *prepared fats*, including the preliminary test, 0.01 mark per kilogram of a homogeneous shipment (§ 12, paragraph 3, of the regulations D, concerning the carrying out of the law). However, the minimum fee for chemical examination of meat amounts to 1 mark, for that of fats 0.40 mark for every package of the shipment. In the case of assorted shipments, or when in case of condemnation of a sample [taken at random] the examination with reference to the ground of condemnation is undertaken for the entire homogeneous shipment (§ 12, paragraph 4, of the regulations D, concerning the carrying out of the law), double the fees are to be paid.

Pfennig amounts [other than multiples of 5] in the final total are to be rounded out to the next higher number divisible by 5.

§ 6.

For the chemical examination of prepared meat for [to determine] the presence of horse meat (§ 14, paragraph 3, under *a* of the regulations D, concerning the carrying out of the law), when the suspicion is confirmed by the examination, a fee of 0.15 mark for every kilogram of the shipment is collected. For the examination of hams in shipments under 10 pieces, of bacon and of casings, likewise of fresh meat for [to determine] the presence of the materials mentioned in § 5, No. 3, of the regulations D, concerning the carrying out of the law (§ 14, paragraph 3, under *b*, § 13, paragraph 2, of the regulations D, concerning the carrying out of the law), under the same condition, a fee of 0.05 mark is to be paid for every kilogram of the shipment.

The minimum fee for inspection for [to determine] the presence of horse meat amounts to 15 marks, that for the examination for [to determine] the presence of the prohibited materials 2.50 marks for one shipment.

§ 7.

In so far as the fees for inspection are to be calculated according to the weight of the wares, the net weight is to be used as a basis. For the purpose of determining this weight, so far as [in case] it is not obtained directly by weighing, the procedure is to be according to the regulations prescribed for the determination of the net weight by the customs office. The gross weight for this purpose is to be taken from the declaration, so far as the statements may be considered as reliable and sufficient.

In so far as the weight determined by the customs office is already known at the time of the calculating of the fees, it can be used as a basis for the latter.

§ 5.

Unbeschadet der nach Massgabe des § 6 zur Erhebung gelangenden Gebühren betragen die Gebühren für die chemische Untersuchung von zubereitetem Fleische, ausgenommen Fett, 0,02 M., für die chemische Untersuchung von zubereitetem Fette, einschliesslich der Vorprüfung, 0,01 M. für jedes Kilogramm einer gleichartigen Sendung (§ 12 Abs. 3 der Ausführungsbestimmungen D). Jedoch beträgt die Mindestgebühr bei der chemischen Untersuchung von Fleisch 1 M., bei der von Fetten 0,40 M. für jedes Packstück der Sendung. Bei nicht gleichartigen Sendungen, oder wenn im Falle der Beanstandung einer Stichprobe die Untersuchung in bezug auf den Beanstandungsgrund an der ganzen gleichartigen Sendung vorgenommen wird (§ 12 Abs. 4 der Ausführungsbestimmungen D), sind die doppelten Gebühren zu entrichten.

Pfennigbeträge bei der Endsumme sind auf eine durch 5 teilbare Zahl nach oben abzurunden.

§ 6.

Für die chemische Untersuchung von zubereitetem Fleische auf das Vorhandensein von Pferdefleisch (§ 14 Abs. 3 unter *a* der Ausführungsbestimmungen D) wird, wenn der Verdacht durch die Untersuchung bestätigt wird, eine Gebühr von 0,15 M. für jedes Kilogramm der Sendung erhoben. Für die Untersuchung von Schinken in Sendungen unter 10 Stück, von Speck und von Därmen, desgleichen von frischem Fleische auf die Anwesenheit der im § 5 Nr. 3 der Ausführungsbestimmungen D genannten Stoffe (§ 14 Abs. 3 unter b, § 13 Abs. 2 der Ausführungsbestimmungen D) ist unter der gleichen Bedingung eine Gebühr von 0,05 M. für jedes Kilogramm der Sendung zu entrichten.

Die Mindestgebühr bei der Untersuchung auf das Vorhandensein von Pferdefleisch beträgt 15 M. diejenige bei der Untersuchung auf die Anwesenheit der verbotenen Stoffe 2,50 M. für eine Sendung.

§ 7.

Insoweit die Untersuchungsgebühren nach dem Gewichte der Ware zu berechnen sind, ist das Nettogewicht zu Grunde zu legen. Behufs Ermittelung dieses Gewichts ist, soweit nicht eine Nettoverwiegung eintritt, nach den für die zollamtliche Ermittelung des Nettogewichts vorgeschriebenen Bestimmungen zu verfahren. Das Bruttogewicht kann zu diesem Zwecke aus der Deklaration entnommen werden, sofern die Angaben als zuverlässig und ausreichend anzusehen sind.

Insoweit das zollamtlich ermittelte Gewicht zur Zeit der Gebührenberechnung bereits bekannt ist, kann es der letzteren zu Grunde gelegt werden.

§ 8.

In case the shipment is voluntarily withdrawn (§ 12, paragraph 6, of the regulations D, concerning the carrying out of the law), upon the ground of the condemnation of a sample [taken at random], the fees established in § 2 under B, Nos. 6 to 8, and those established in § 4 are to be collected only for that part of the shipment upon which the examinations in question are already made up to the time of withdrawal. In so far as only inspections of samples [taken at random] have taken place, of the total fees to be calculated for the entire shipment according to § 2 under B, Nos. 6 to 8, that proportional amount is to be collected which corresponds to the relation of the number of the samples inspected to the total number of the samples taken.

In similar case only half of the fees established in § 5 are to be collected, when up to the time of the withdrawal not more than half of the samples taken for the purpose of the chemical examination of the meat or for the principal test of the fat are examined. The single samples are considered as examined even when only one of the tests described in the directions for the chemical examination of meat and fats is made. If more than half of the samples are already examined the full fees are to be collected for the entire shipment.

§ 9.

The determination and fixing of the costs devolving upon the complainant for an unfounded complaint, in the case of § 30, paragraph 1, of the regulations D, concerning the carrying out of the law, takes place according to the ordinances issued with regard thereto by the [separate] federated governments.

§ 10.

The authorities may require before the beginning of the examination the payment of a suitable deposit to be determined by them. If in the cases of § 6 the suspicion is proved unfounded, or the shipment is voluntarily withdrawn (§ 8), the corresponding amounts are to be paid back.

THE IMPERIAL CHANCELLOR (REICHSKANZLER),
COUNT v. POSADOWSKY, *Acting.*

BERLIN, *July 13, 1902.*

§ 8.

Falls die Sendung auf Grund der Beanstandung einer Stichprobe freiwillig zurückgezogen wird (§ 12 Abs. 6 der Ausführungsbestimmungen D), sind die im § 2 unter B Nr. 6 bis 8 und die im § 4 festgesetzten Gebühren nur von demjenigen Teile der Sendung zu erheben, an welchem die betreffenden Untersuchungen zur Zeit der Zurückziehung bereits ausgeführt sind. Insoweit nur Stichproben-Untersuchungen stattgefunden haben, ist von der für die Gesamtsendung nach § 2 unter B Nr. 6 bis 8 zu berechnenden Gebührensumme derjenige Teilbetrag zu erheben, welcher dem Verhältnisse der Zahl der untersuchten Stichproben zu der Gesamtzahl der entnommenen Stichproben entspricht.

Im gleichen Falle sind die im § 5 festgesetzten Gebühren nur zur Hälfte zu erheben, wenn zur Zeit der Zurückziehung nicht mehr als die Hälfte der zum Zwecke der chemischen Untersuchung des Fleisches oder zur Hauptprüfung des Fettes entnommenen Proben untersucht ist. Die einzelnen Proben gelten schon dann als untersucht, wenn auch nur eine der in der Anweisung für die chemische Untersuchung von Fleisch und Fetten beschriebenen Prüfungen ausgeführt ist. Ist bereits mehr als die Hälfte der Proben untersucht, so sind die vollen Gebühren von der ganzen Sendung zu erheben.

§ 9.

Die Bemessung und Festsetzung der im Falle des § 30 Abs. 1 der Ausführungsbestimmungen D dem Beschwerdeführer zur Last fallenden Kosten einer unbegründeten Beschwerde erfolgt nach Massgabe der hierüber ergehenden Anordnungen der Landesregierungen.

§ 10.

Die Behörde kann die Einzahlung eines angemessenen von ihr zu bestimmenden Vorschusses vor Beginn der Untersuchung verlangen. Wenn in den Fällen des § 6 der Verdacht als unbegründet sich erweist, oder die Sendung freiwillig zurückgezogen wird (§ 8), sind die entsprechenden Beträge zurückzuzahlen.

Berlin, *den 12. Juli 1902.*

Der Reichskanzler.
In Vertretung: Graf v. Posadowsky.

The Bundesrath in its session of January 29 of this year resolved to approve the following printed meat-inspection customs ordinance:

v. FISCHER.

BERLIN, *February 5, 1903.*

By authority of the Imperial Chancellor.

Meat-inspection customs ordinance.

I. *Limitations of importation and shipment in [direct] transit.*

§ 1.

The following can not be imported past the customs line:

1. Meat in hermetically sealed cans or similar vessels, sausages and other mixtures of chopped meat (§12, paragraph 1, of the law concerning the inspection of food animals and of meat of June 3, 1900 [Reichs-Gesetzbl., p. 547], and § 5, No. 1, of the regulations D issued by the Bundesrath concerning that law).

2. Dog meat as well as prepared meat which comes from horses, asses, mules, hinnies, or other animals of the soliped genus (§ 15 of the law and § 5 No. 2, of the regulations D concerning the carrying out of the law).

3. Meat which has been treated with one of the following materials or with a preparation containing such materials—

(*a*). Boracic acid and its salts.

(*b*) Formaldehyde.

(*c*) Alkali and alkaline earth hydroxides and carbonates.

(*d*) Sulphurous acid and its salts as well as hyposulphites.

(*e*) Hydrofluoric acid and its salts.

(*f*) Salicylic acid and its compounds.

(*g*) Chlorates.

(*h*) Dyes of all kinds, however, without prejudice to their use for coloring margarine yellow and for the coloring of sausage skins, in so far as this use does not contravene other provisions

(§ 21 of the law and § 5, No. 3, of the regulations D concerning the carrying out of the law).

4. Fresh meat which with reference to the size (entire carcasses and half carcasses) and to the connection with [possession of] internal organs and other portions of the body does not comply with the provisions of § 12, paragraph 2, No. 1, of the law as well as of § 6 of the regulations D concerning the carrying out of the law.

5. Fresh horse meat which is not made recognizable as horse meat by a designation in the German language (§ 18, paragraph 2, of the law).

Der Bundesrat hat in seiner Sitzung vom 29. Januar d. J. beschlossen, der nachstehend abgedruckten Fleischbeschau-Zollordnung die Zustimmung zu erteilen.

Berlin, *den 5. Februar 1903.*

Der Reichskanzler.
Im Auftrage: v. Fischer.

Fleischbeschau-Zollordnung.

I. *Beschränkungen der Ein- und Durchfuhr.*

§ 1.

In das Zollinland dürfen nicht eingeführt werden:

1. Fleisch in luftdicht verschlossenen Büchsen oder ähnlichen Gefässen, Würste und sonstige Gemenge aus zerkleinertem Fleische (§ 12 Abs. 1 des Gesetzes, betreffend die Schlachtvieh- und Fleischbeschau, vom 3. Juni 1900 [Reichs-Gesetzbl., S. 547] und § 5 Ziffer 1 der dazu vom Bundesrat erlassenen Ausführungsbestimmungen D);

2. Hundefleisch, sowie zubereitetes Fleisch, welches von Pferden, Eseln, Maultieren, Mauleseln oder anderen Tieren des Einhufergeschlechts herrührt (§ 15 des Gesetzes und § 5 Ziffer 2 der Ausführungsbestimmungen D);

3. Fleisch, welches mit einem der folgenden Stoffe oder mit einer solche Stoffe enthaltenden Zubereitung behandelt worden ist:

a) Borsäure und deren Salze,

b) Formaldehyd,

c) Alkali- und Erdalkali-Hydroxyde und -Karbonate,

d) Schweflige Säure und deren Salze sowie unterschwefligsaure Salze,

e) Fluorwasserstoff und dessen Salze,

f) Salicylsäure und deren Verbindungen,

g) Chlorsaure Salze,

h) Farbstoffe jeder Art, jedoch unbeschadet ihrer Verwendung zur Gelbfärbung der Margarine und zum Färben der Wursthüllen, sofern diese Verwendung nicht anderen Vorschriften zuwiderläuft (§ 21 des Gesetzes und § 5 Ziffer 3 der Ausführungsbestimmungen D);

4. Frisches Fleisch, das in bezug auf die Grösse (ganze und halbe Tierkörper) und auf den Zusammenhang mit inneren Organen und sonstigen Körperteilen den Vorschriften des § 12 Abs. 2 Ziffer 1 des Gesetzes sowie des § 6 der Ausführungsbestimmungen D nicht entspricht;

5. Frisches Pferdefleisch, das nicht durch eine Bezeichnung in deutscher Sprache als Pferdefleisch erkennbar gemacht ist (§ 18 Abs. 2 des Gesetzes);

6. Pickled (salted) meat in pieces of less weight than 4 kilograms, with the exception of hams, bacon, and casings (§ 12, paragraph 2, No. 2, of the law and § 7, paragraph 1, of the regulations D concerning the carrying out of the law).

§ 2.

What wares fall under the above prohibitions is determined according to the regulations in §§ 1 to 4, and § 7, paragraph 2, of the regulations D concerning the carrying out of the law.

§ 3.

Shipment in direct transit under custom-house escort or under customs seal, in postal traffic also without these means of control is not to be considered as importation in the sense of the above regulations.

As shipment in direct transit, only that transportation of wares is to be considered which is accomplished without a longer stay in the inland than is made necessary for the proper transportation of wares. A shipment in direct transit especially does not obtain in the case of storage of the wares in a customs warehouse under official seal (§ 10 of the regulations D concerning the carrying out of the law).

§ 4.

The importation prohibitions of § 1, Nos. 1, 2, 4 to 6, do not apply:

1. To meat which in the case of § 26 is reimported from the inland through a region outside the customs line to a point inside the customs line.

2. To meat which is taken along for use on a journey. Here belongs especially meat which is taken by sea ships as ship provisions from the country outside the customs line and is not removed from the ship; meat which is in excess of the probable need of the crew during the remaining of the ship in the inland is to be placed under customs seal; customs seal may be omitted when the ship is under special customs surveillance (§ 14, paragraph 1, of the law, and § 4, paragraph 1, last sentence of the regulations D concerning the carrying out of the law).

3. To meat inspected according to the regulations, that has been sent from the inland to the country outside the customs line, from there returns in unchanged condition and is left free of the importation duty.

4. To meat which is not intended for food for man, under the condition that it is made unfit for use as food in the prescribed way (§ 21).

6. Pökel-(Salz-)Fleisch in Stücken von geringerem Gewicht als ½ kg., ausgenommen Schinken, Speck und Därme (§ 12 Abs. 2 Ziffer 2 des Gesetzes und § 7 Abs. 1 der Ausführungsbestimmungen D).

§ 2.

Welche Waren unter die vorstehenden Verbote fallen, regelt sich nach den Bestimmungen in den §§ 1 bis 4 and § 7 Abs. 2 der Ausführungsbestimmungen D.

§ 3.

Die unmittelbare Durchfuhr unter zollamtlicher Begleitung oder unter Zollverschluss, im Postverkehr auch ohne diese Kontrolmittel, ist als Einfuhr im Sinne der vorstehenden Bestimmungen nicht zu betrachten.

Als unmittelbare Durchfuhr ist nur derjenige Warendurchgang anzusehen, der sich vollzieht ohne längere Aufenthaltsdauer im Inland, als durch die ordnungsmässige Warenbeförderung bedingt ist. Eine unmittelbare Durchfuhr liegt insbesondere nicht vor bei Aufbewahrung der Waren in einem Zollager unter amtlichem Verschlusse (§ 10 der Ausführungsbestimmungen D).

§ 4.

Die Einfuhrverbote des § 1 Ziffer 1, 2, 4 bis 6 finden keine Anwendung:

1. auf Fleisch, welches im Falle des § 26 vom Inlande durch das Ausland nach dem Inlande versendet wird;

2. auf Fleisch, welches zum Reiseverbrauche mitgeführt wird. Hierher gehört insbesondere Fleisch, welches von Seeschiffen als Schiffsproviant aus dem Zollauslande mitgeführt und nicht vom Schiffe entfernt wird; das Fleisch, welches den mutmasslichen Bedarf der Schiffsmannschaft während der Dauer des Aufenthalts des Schiffes im Inland übersteigt, ist unter zollamtlichen Verschluss zu setzen; von der Verschlussanlage kann abgesehen werden, wenn das Schiff unter besonderer Zollbewachung steht (§ 14 Abs. 1 des Gesetzes und § 4 Abs. 1 letzter Satz der Ausführungsbestimmungen D);

3. auf vorschriftsmässig untersuchtes Fleisch, das aus dem Inlande nach dem Zollauslande gesendet worden ist, von da in unverändertem Zustande zurückkommt und vom Eingangszolle freigelassen wird;

4. auf Fleisch, welches nicht zum menschlichen Genusse bestimmt ist, unter der Voraussetzung, dass es in der vorgeschriebenen Weise ungeniessbar gemacht wird (§ 21).

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§ 5.

To meat imported in the minor frontier trade as well as in trade at fairs and markets in the frontier district the importation prohibitions of § 1 apply in so far as the [separate] federated governments do not grant exceptions to the prohibitions mentioned in § 1, Nos. 1, 2, 4 to 6 (§ 14, paragraph 2, of the law, and § 9 of the regulations D concerning the carrying out of the law).

§ 6.

If before the examination of the meat by the inspection office the suspicion arises among the customs authorities that, either intentionally or through negligence, an importation prohibition is contravened, the customs authorities shall place a provisional embargo upon the wares and notify the state attorney, so that in accordance with §§ 26 to 28 of the law punitive proceedings may be instituted or the independent confiscation can be brought about.

§ 7.

If there is not present the suspicion of an intentional violation or a violation through negligence of an importation prohibition, the meat imported contrary to the prohibition is to be taken back to the outland under customs surveillance. In place of reexportation the destruction of the wares shall take place under customs surveillance, when the person having charge of the wares agrees to the destruction or refuses to provide for the reexportation of the wares to the outland.

If the meat is spoiled or if there is other cause for objections on the part of the sanitary or veterinary police, the police authorities are to be informed so that the necessary protective measures may be taken.

The procedure shall be according to the above provisions also when, in the case of § 6, the confiscation of the meat is not ordered by the state attorney or is refused by the court.

If contraventions of an importation prohibition are not discovered until the examination of the meat by the inspection office, the confiscation devolves upon the inspection office, who shall immediately inform the customs authorities of this (§ 24 of the regulations D, concerning the carrying out of the law).

II. *Procedure in the importation of meat.*

§ 8.

The importation of meat may take place only through the customs offices designated by the Bundesrath. In how far the authority of the head offices thus designated may be exercised by the independent dis-

§ 5.

Auf das im kleinen Grenzverkehre sowie im Mess- und Marktverkehre des Grenzbezirkes eingehende Fleisch finden die Einfuhrverbote des § 1 Anwendung, soweit die Landesregierungen nicht von den im § 1 Ziffer 1, 2, 4 bis 6 bezeichneten Verboten Ausnahmen zulassen (§ 14 Abs. 2 des Gesetzes und § 9 der Ausführungsbestimmungen D).

§ 6.

Entsteht vor der Untersuchung des Fleisches durch die Beschaustelle bei der Zollbehörde der Verdacht, dass einem Einfuhrverbote wissentlich oder fahrlässig zuwidergehandelt ist, so hat die Zollbehörde die Ware vorläufig in Beschlag zu nehmen und die Staatsanwaltschaft zu benachrichtigen, damit auf Grund der §§ 26 bis 28 des Gesetzes das Strafverfahren eingeleitet oder die selbständige Einziehung des Fleisches herbeigeführt werden kann.

§ 7.

Liegt der Verdacht einer wissentlichen oder fahrlässigen Verletzung eines Einfuhrverbots nicht vor, so ist das verbotswidrig eingeführte Fleisch unter zollamtlicher Überwachung in das Ausland zurückzuschaffen. An Stelle der Wiederausfuhr hat die Vernichtung der Ware unter zollamtlicher Mitaufsicht zu erfolgen, wenn der Verfügungsberechtigte mit der Vernichtung einverstanden ist oder es ablehnt, für die Zurückschaffung der Waren in das Ausland zu sorgen.

Ist das Fleisch verdorben oder gibt es sonst zu gesundheits- oder veterinärpolizeilichen Bedenken Verlanlassung, so ist die Polizeibehörde behufs Ergreifung der erforderlichen Sicherungsmassregeln zu benachrichtigen.

Nach den vorstehenden Vorschriften ist auch zu verfahren, wenn im Falle des § 6 die Einziehung des Fleisches von der Staatsanwaltschaft nicht beantragt oder vom Gericht abgelehnt wird.

Werden Zuwiderhandlugen gegen ein Einfuhrverbot erst bei der Untersuchung des Fleisches durch die Beschaustelle entdeckt, so liegt die Beschlagnahme der Beschaustelle ob, welche hiervon der Zollbehörde sofortige Mitteilung zu machen hat (§ 24 der Ausführungsbestimmungen D).

II. *Verfahren bei der Einfuhr von Fleisch.*

§ 8.

Die Einfuhr von Fleisch darf nur über die vom Bundesrate bestimmten Zollstellen erfolgen. Inwieweit die Befugnisse der danach zuständigen Hauptämter von den an deren Sitzen befindlichen

patching offices located at their place is determined by the authorities of the [separate] federated governments.

The importation of meat may be limited in given places to certain days by the [separate] federated governments.

In postal trade (§ 24), as well as in the case of meat taken along for use on journeys (§ 11, No. 1), meat may be imported through all the frontier customs offices, [and] in the case of shipment in direct transit (§ 11, No. 2), and in case of § 26, [meat may be imported] through all the frontier customs offices provided with the necessary authority [customs clearance authority].

§ 9.

Meat imported past the customs line is subject to an official examination (inspection) with cooperation of the customs authorities, whose competency is determined by § 8, paragraph 1.

What is to be considered as meat in the sense of this customs ordinance is regulated according to the general provisions in §§ 1 to 4 of the regulations D, concerning the carrying out of the law.

§ 10.

Meat which is proved to have been already inspected in the inland according to regulations, and that has been carried outside the customs line, is not subjected to official inspection in case it is reimported in an unchanged condition. As being proved to have been inspected according to regulations is not regarded such foreign meat as has been examined at an inspection office situated outside the customs line [Zollausland] and which, without being first brought to a proper customs office for clearance according to § 26, has been shipped through a region outside the frontier [Ausland] to [a point] within the customs line [Inlande].

§ 11.

Further, the following are not subject to inspection:

1. Meat taken by travelers for use on a journey. Here belongs especially meat taken along by sea ships as ship provisions, so far as [in case] it is not removed from the ship; meat which is in excess of the probable need of the crew during the ship's stay in the inland is to be placed under customs seal; the customs seal may be omitted when the ship is under special customs surveillance.

2. Meat intended for shipment in direct transit.

Shipment in direct transit which is to be expressly proposed in the the customs papers shall take place on Permit [Begleitschein] I or on

selbständigen Abfertigungsstellen ausgeübt werden, bestimmen die Landesbehörden.

Die Einfuhr von Fleisch kann von den Landesbehörden bei einzelnen Stellen auf bestimmte Tage beschränkt werden.

Im Postverkehre (§ 24) sowie im Reiseverkehre (§ 11 Ziffer 1) darf Fleisch über sämmtliche, bei der unmittelbaren Durchfuhr (§ 11 Ziffer 2) und im Falle des § 26 über alle mit den entsprechenden Zollabfertigungsbefugnissen versehenen Grenzzollämter eingehen.

§ 9.

Das in das Zollinland eingeführte Fleisch unterliegt einer amtlichen Untersuchung (Beschau) unter Mitwirkung der Zollbehörden, auf deren Zuständigkeit der § 8 Abs. 1 entsprechende Anwendung findet.

Was als Fleisch im Sinne dieser Zollordnung anzusehen ist, regelt sich nach den allgemeinen Vorschriften in den §§ 1 bis 4 der Ausführungsbestimmungen D.

§ 10.

Das nachweislich im Inlande bereits vorschriftsmässig untersuchte und nach dem Zollauslande verbrachte Fleisch ist im Falle der Zurückbringung in unverändertem Zustande der amtlichen Untersuchung nicht unterworfen. Als nachweislich vorschriftsmässig untersucht gilt nicht solches ausländisches Fleisch, welches bei einer im Zollauslande belegenen Beschaustelle untersucht und ohne vorher einer zuständigen Zollstelle zur Abfertigung nach Massgabe des § 26 vorgeführt zu sein, durch das Ausland nach dem Inlande versendet worden ist.

§ 11.

Der Untersuchung unterliegt ferner nicht:

1. das von Reisenden zum Verbrauch auf der Reise mitgeführte Fleisch. Hierher gehört insbesondere das von Seeschiffen als Schiffsproviant mitgeführte Fleisch, sofern es nicht vom Schiffe entfernt wird; das Fleisch, welches den mutmasslichen Bedarf der Schiffsmannschaft während der Dauer des Aufenthalts des Schiffes im Inland übersteigt, ist unter zollamtlichen Verschluss zu setzen; von der Verschlussanlage kann abgesehen werden, wenn das Schiff unter besonderer Zollbewachung steht;

2. das zur unmittelbaren Durchfuhr bestimmte Fleisch.

Die unmittelbare Durchfuhr, welche im Zollpapier ausdrücklich zu beantragen ist, hat auf Begleitschein I oder Begleitzettel und unter

a permit-slip [Begleitzettel] and under customs seal, and indeed, in so far as possible, in a sealed compartment. In place of sealing for shorter journeys custom-house escort may be substituted. The permits [Begleitscheine] or permit-slips [Begleitzettel] made out for such meat shipments receive on the upper border of the first page the mark "meat inspection" to be made with a colored pencil or by means of stamping. In the records of these permits [Begleitscheine] or permit-slips [Begleitzettel] in a proper place the same mark is to be made.

In the case of shipment in direct transit by post the making out of a permit as well as customs seal or custom-house escort may be omitted.

§ 12.

Meat imported in the small frontier trade as well as in trade at fairs and markets in the frontier district is subject to inspection according to this customs ordinance so far as the [separate] federated governments do not grant exceptions in accordance with § 14, paragraph 2, of the law.

§ 13.

In the case of importation of meat subject to inspection the person having charge of the wares has the choice as to whether he will have the examination undertaken at the frontier inspection office, when there is present at that place an authorized office for the examination that is to be made, or whether he shall have it made at another competent inspection office in the interior.

Upon the entry [of the wares] he shall notify the customs office in writing to what inspection office he wishes the examination of the meat delegated. When according to the customs regulations a written declaration of wares has to take place, the notification is to be made in this.

If the notification does not take place within a period to be fixed once for all by the frontier office and if reexportation is not asked for the examination shall be made officially at the frontier inspection office, or, in case there is at this place no inspection office authorized for examination, at a neighboring inspection office to be designated by the [frontier] office.

§ 14.

If the examination takes place at the frontier office, first of all a custom-house inspection [revision] shall take place. How far the latter is to be extended the director of the customs office shall determine; however, at least the number and kind of the packages is always to be established.

zollamtlichem Verschluss, und zwar nach Möglichkeit unter Raumverschluss, zu erfolgen. An Stelle des Verschlusses kann auf kürzere Strecken zollamtliche Begleitung treten. Die über derartige Fleischsendungen ausgestellten Begleitscheine oder Begleitzettel erhalten am oberen Rande der ersten Seite den mit Buntstift oder durch Stempelabdruck zu bewirkenden Vermerk "Fleischbeschau." In die über diese Begleitscheine oder Begleitzettel geführten Register ist an geeigneter Stelle derselbe Vermerk aufzunehmen.

Bei der unmittelbaren Durchfuhr mit der Post kann von der Ausstellung eines Begleitscheins sowie von der Anlegung eines Zollverschlusses oder von zollamtlicher Begleitung abgesehen werden.

§ 12.

Das im kleinen Grenzverkehre sowie im Mess- und Marktverkehre des Grenzbezirkes eingehende Fleisch unterliegt der Untersuchung nach Massgabe dieser Zollordnung, soweit die Landesregierungen nicht auf Grund des § 14 Abs. 2 des Gesetzes Ausnahmen zulassen.

§ 13.

Bei der Einfuhr beschaupflichtigen Fleisches hat der Verfügungsberechtigte die Wahl, ob er die Untersuchung bei der Beschaustelle des Eingangsamts, sofern daselbst eine für die vorzunehmende Untersuchung befugte Stelle vorhanden ist, oder bei einer anderen zuständigen Beschaustelle im Innern vornehmen lassen will.

Er hat bei dem Eingange der Zollstelle schriftlich anzumelden, welcher Beschaustelle er die Untersuchung des Fleisches zu übertragen wünscht. Wenn nach den zollrechtlichen Bestimmungen eine schriftliche Warendeklaration zu erfolgen hat, so ist die Anmeldung in dieser zu bewirken.

Erfolgt die Anmeldung nicht innerhalb einer von dem Eingangsamt ein für allemal anzuordnenden Frist, und wird nicht die Wiederausfuhr beantragt, so ist die Untersuchung bei der Beschaustelle des Eingangsamts oder, falls sich bei diesem eine zur Untersuchung befugte Beschaustelle nicht befindet, bei einer benachbarten, von dem Amte zu bestimmenden Beschaustelle von Amts wegen vorzunehmen.

§ 14.

Findet die Untersuchung beim Eingangsamte statt, so ist zunächst eine zollamtliche Revision der Ware vorzunehmen. Wie weit diese auszudehnen ist, bestimmt der Vorstand der Zollstelle; doch ist stets mindestens die Zahl und Art der Packstücke festzustellen.

Wares subject to meat inspection remain until the end and, in case of § 15, paragraph 3, until the beginning of the examination under customs seal, or in case this can not be accomplished they may, with the permission of the director of the head office, remain under customs surveillance.

The custom-house inspections [revisions] of fresh meat to be undertaken according to paragraph 1 take precedence over those of other wares presented at the same time in so far as § 27 of the customs law [Vereinszollgesetz] does not prevent. The customs inspection [revision] takes place at a regular customs office. Upon application it may be granted by the director of the customs office that it shall be undertaken at other places (for example, at the [meat] inspection office). Such a permission is to be granted only when at these places there are suitable rooms available in which the wares may be kept under customs seal until the end of the revision and inspection, or under customs surveillance in case the director of the head office has granted this according to the previous paragraph.

§ 15.

As soon as the wares subject to inspection arrive the customs office shall inform the [meat] inspection office of this, so far as [in case] in connection with the latter there are no regular times [established] once for all for the inspection and taking of samples (paragraph 2).

The [meat] inspection office undertakes—so far as possible immediately following upon the customs inspection [revision]—the prescribed examination of the meat, takes out the samples necessary for inspection, whose weight is to be established by the customs office, and receives the accompanying papers at hand concerning the shipment. The reception of the samples and of the accompanying papers it shall recognize in a transfer book kept by the customs office according to Model I. [For Model I, see p. 26].

It is permissible to convey the shipment itself to the [meat] inspection office under custom-house escort or under customs seal. This conveying is to be attended to by the person having charge of the wares. With regard to these shipments, a transfer book according to Model II [for Model II, see p. 26] is kept by the customs office, in which the [meat] inspection office shall acknowledge the receipt of the shipments and accompanying papers. In these cases the inspector is to be placed under oath for the customs duties, that the customs claims with respect to the meat turned over to the [meat] inspection office may be made secure.

The administrative authorities are authorized to issue more specific provisions with regard to the traffic between the several offices [customs offices] and the [meat] inspection offices, if need be, after agreement with the officials superior to the latter.

Der Fleischbeschau unterliegende Waren bleiben bis zur Beendigung und im Falle des § 15 Abs. 3 bis zum Beginn der Untersuchung unter zollamtlichem Verschluss oder, falls ein solcher nicht durchzuführen ist, mit Genehmigung des Hauptamtsvorstandes unter zollamtlicher Aufsicht.

Die gemäss Abs. 1 vorzunehmenden Revisionen frischen Fleisches erhalten, soweit nicht der § 27 des Vereinszollgesetzes entgegensteht, den Vorrang vor denjenigen anderer, gleichzeitig vorgeführter Waren. Die Revision findet an ordentlicher Amtsstelle statt. Auf Antrag kann von dem Vorstande der Zollstelle genehmigt werden, dass sie an anderen Orten (z. B. an der Beschaustelle) vorgenommen wird. Eine solche Genehmigung ist nur dann zu erteilen, wenn an diesen Orten geeignete Räume zur Verfügung stehen, in denen die Ware bis zur Beendigung der Revision und Untersuchung unter zollamtlichem Verschluss oder, falls der Hauptamtsvorstand dies gemäss dem vorigen Absatze zugelassen hat, unter zollamtlicher Aufsicht gehalten werden kann.

§ 15.

Alsbald nach dem Eintreffen beschaupflichtiger Waren hat die Zollstelle der Beschaustelle hiervon Nachricht zu geben, sofern nicht mit dieser ein für allemal regelmässige Zeiten für die Besichtigung und Probeentnahme (Abs. 2) vereinbart sind.

Die Beschaustelle nimmt—und zwar, soweit möglich, im unmittelbaren Anschluss an die zollamtliche Revision—die vorgeschriebene Besichtigung des Fleisches vor, entnimmt die für die Untersuchung erforderlichen Proben, deren Gewicht zollamtlich festzustellen ist, und erhält die über die Sendung vorhandenen Begleitpapiere. Den Empfang der Proben und der Begleitpapiere hat sie in einem von der Zollstelle nach Muster I geführten Überweisungsbuch anzuerkennen.

Es ist zulässig, die Sendung selbst der Beschaustelle unter zollamtlicher Begleitung oder unter Zollverschluss zuzuführen. Die Zuführung hat der Verfügungsberechtigte zu bewirken. Über diese Sendungen wird von der Zollstelle ein Überweisungsbuch nach Muster II geführt, in welchem die Beschaustelle den Empfang der Sendungen und Begleitpapiere anzuerkennen hat. Für diese Fälle ist der Beschauer zur Sicherung des Zollanspruchs hinsichtlich des der Beschaustelle überwiesenen Fleisches auf das Zollinteresse zu vereidigen.

Die Direktivbehörden sind ermächtigt, nähere Vorschriften über den Verkehr zwischen den einzelnen Amtsstellen und den Beschaustellen, erforderlichenfalls im Einvernehmen mit den den letzteren vorgesetzten Behörden, zu erlassen.

[*Model I for the transfer book.*]

Serial No.	Transfer of meat samples.												Clearance.						Remarks.
	Of the transfer.		Of the customs register.		Name and place of residence of the—		Of the packages from which samples are taken.			Weight of the samples determined by the customs office (kg.).	Designation and number of the—		Signature of the meat-inspection office certifying reception.	The meat is (a) passed, (b) destroyed, (c) to be reexported.	Of the samples have been—		Designation and number of the returned—		Signature of the official as a certificate of receiving the returned wares (columns 10b and 11).	
	Day.	Hour.	Designation.	Number.	Sender.	Addressee.	Number and kind.	Designation.	Content.		Customs papers.	Other accompanying papers.			Used (kg.).	Returned (kg.).	Customs papers.	Other accompanying papers.		
1.	2.		3.		4.		5.			6.	7.		8.	9.	a. 10. b.		11.		12.	13.

[*Model II for the transfer book.*]

Serial No.	Transfer.											Clearance.				Remarks.
	Of the transfer.		Of the customs register.		Name and place of residence of the—		Customs office findings with regard to the packages.			Designation and number of the—		Signature of the [meat] inspection office as certificate of receiving.	The meat is (a) passed, (b) disposed of, (c) to be reexported.	The shipment is—		Signature of the official as a certificate of receiving the returned wares (columns 6 and 9b).	
	Day.	Hour.	Designation.	Number.	Sender.	Addressee.	Number and kind.	Designation.	Weight.	Content determined.	Sealing or escort.	Customs papers.	Other accompanying papers.			Handed over to the addressee.	Returned to the customs office.		
1.	2.		3.		4.		5.					6.		7.	8.	a. 9. b.		10.	11.

Muster I zum Überweisungsbuche.

Lfd Nr	Überweisung von Fleischproben.											Erledigung.							Bemerkungen.
	Der Überweisung		Des Zollregisters		Name und Wohnort des		Der Packstücke, aus denen Proben entnommen sind,			Zollamtlich ermitteltes Gewicht der Proben. kg.	Bezeichnung und Stückzahl der		Unterschrift der Beschaustelle als Empfangsbescheinigung.	Das Fleisch ist: a) freigegeben, b) vernichtet, c) wieder auszuführen.	Von den Proben sind		Bezeichnung und Stückzahl der zurückgegebenen		Unterschrift des Beamten als Bescheinigung über den Rückempfang (Spalte 10 b u. 11).	
	Tag.	Stunde	Bezeichnung.	Nummer	Absenders.	Empfängers.	Zahl und Art.	Bezeichnung.	Inhalt.		Zollpapiere.	sonstigen Begleitpapiere.			verbraucht. kg.	zurückgegeben. kg.	Zollpapiere.	sonstigen Begleitpapiere.		
1.	2.		3.		4.		5.			6.	7.		8.	9.	a. 10.	b.	11.		12.	13.

Muster II zum Überweisungsbuche.

Lfd. Nr.	Überweisung.						Zollamtlicher Befund der Packstücke				Bezeichnung und Stückzahl der		Unterschrift der Beschaustelle als Empfangsbescheinigung.	Das Fleisch ist: a) freigegeben, b) beseitigt, c) wieder auszuführen.	Die Sendung ist		Unterschrift des Beamten als Bescheinigung über den Rückempfang (Spalte 6 u. 9 b).	Bemerkungen.
	Der Überweisung		Des Zollregisters		Name und Wohnort des										dem Empfänger ausgehändigt.	der Zollstelle zurückgegeben.		
	Tag.	Stunde.	Bezeichnung.	Nummer.	Absenders.	Empfängers.	Zahl und Art.	Bezeichnung.	Gewicht.	ermittelter Inhalt.	Verschluss oder Begleitung.	Zollpapiere.	sonstigen Begleitpapiere.		a. 9.	b.		
1.	2.		3.		4.				5.			6.		7.	8.		10.	11.

§ 16.

The customs office receives, in addition to the information considered in §§ 24 and 30 of the regulations D concerning the carrying out of the law, from the [meat] inspection office on the return of the accompanying papers, a written report as to the final result of the inspection, which is to be stamped upon the customs papers at hand concerning the shipment, or is to be filed as a voucher in the customs registers. In the report also the number of samples used for the purposes of the inspection is to be stated. Upon the basis of the report and of the establishing of the weight prescribed in the following paragraph, the customs office shall fill out in the transfer book the clearance columns [9–12] concerning the disposal of the wares.

The samples taken, not used for the purposes of the inspection, are to be returned to the customs office. So far as [in case] they have, by the examination, been made unfit for use, they are to be destroyed under customs surveillance; otherwise, after the establishing of their weight they are to be placed back with the shipment. The services necessary for this purpose are to be rendered by the person who has charge of the shipment.

If the entire shipment has been brought to the [meat] inspection office (§ 15, paragraph 3), the person having charge of the wares shall take it back again to the customs office, so far as [in case] clearance outside of the regular office is not granted or so far as [in case] the shipment is to be destroyed upon the order of the police authorities. The returning to the customs office shall take place under custom-house escort or under customs seal.

§ 17.

If the examination does not occur at the frontier office the meat is to be turned over to the office (at whose place the inspection is to occur) under customs seal, and in so far as possible under seal in a compartment, or under custom-house escort with Permit [Begleitschein] I, or permit-slip [Begleitzettel].

The permits [Begleitscheine], or permit-slips [Begleitzettel], made out for such meat shipments receive on the upper border of the first page the note "meat inspection," to be made with a colored pencil or by means of a stamp. In the registers kept of these permits [Begleitscheine], or permit-slips [Begleitzettel], the same note is to be made in a suitable place.

After the arrival of the meat shipments at the place where the inspection is to be made, a procedure is to be carried out in accordance with that mentioned in §§ 14 to 16. The inspection [revision] by the customs office (§ 14, paragraph 1) is, however, to be extended at least so far that the decision may be made as to whether the person transporting the wares has fulfilled his obligations in accordance with the permit [Begleitschein], or permit-slip [Begleitzettel].

§ 16.

Die Zollstelle erhält, abgesehen von den in den §§ 24 und 30 der Ausführungsbestimmungen D vorgesehenen Mitteilungen, von der Beschaustelle bei Rückgabe der Begleitpapiere eine schriftliche Benachrichtigung über das endgültige Ergebnis der Untersuchung, welche den über die Sendung vorhandenen Zollpapieren anzustempeln oder als Beleg zu den Zollregistern zu nehmen ist. In der Benachrichtigung ist auch die Menge der für die Zwecke der Untersuchung verbrauchten Proben anzugeben. Auf Grund der Benachrichtigung und der im folgenden Absatze vorgeschriebenen Gewichtsfeststellung hat die Zollstelle die Erledigungsspalten des Überweisungsbuchs auszufüllen.

Die entnommenen, für die Zwecke der Untersuchung nicht verbrauchten Proben sind der Zollstelle wieder auszuhändigen. Sie sind, sofern sie durch die Untersuchung unbrauchbar geworden sind, unter zollamtlicher Aufsicht zu vernichten, anderenfalls nach Feststellung ihres Gewichts der Sendung wieder beizufügen. Die hierzu erforderlichen Hülfsdienste sind von demjenigen zu leisten, welcher das Verfügungsrecht über die Sendung hat.

Ist der Beschaustelle die ganze Sendung zugeführt worden (§ 15 Abs. 3), so hat sie der Verfügungsberechtigte wieder zur Zollstelle zurückzuführen, sofern nicht die Abfertigung ausserhalb der ordentlichen Amtsstelle genehmigt oder die Sendung auf Anordnung der Polizeibehörde zu vernichten ist. Die Zurückführung zur Zollstelle hat unter zollamtlicher Begleitung oder unter Zollverschluss zu erfolgen.

§ 17.

Findet die Untersuchung nicht beim Eingangsamte statt, so ist das Fleisch an das Amt, an dessen Sitz die Untersuchung vorgenommen werden soll, unter zollamtlichem Verschluss, und zwar nach Möglichkeit unter Raumverschluss, oder unter zollamtlicher Begleitung mit Begleitschein I oder Begleitzettel zu überweisen.

Die über derartige Fleischsendungen ausgestellten Begleitscheine oder Begleitzettel erhalten am oberen Rande der ersten Seite den mit Buntstift oder durch Stempelabdruck zu bewirkenden Vermerk: "Fleischbeschau." In die über diese Begleitscheine oder Begleitzettel geführten Register ist an geeigneter Stelle derselbe Vermerk aufzunehmen.

Nach Ankunft der Fleischsendungen an dem Orte, an welchem die Untersuchungen vorzunehmen ist, findet das in den §§ 14 bis 16 bezeichnete Verfahren entsprechende Anwendung. Die zollamtliche Revision (§ 14 Abs. 1) ist jedoch mindestens soweit auszudehnen, dass beurteilt werden kann, ob der Warenführer seinen Verpflichtungen aus dem Begleitschein oder Begleitzettel nachgekommen ist.

§ 18.

After the termination of the inspection and marking of the meat the office at whose place the inspection has occurred shall undertake the further customs clearance.

Meat passed upon the ground of the inspection can finally be placed in free traffic, sent with Permit I or II, or shipped to a public or to a private warehouse.

The administrative authorities are authorized, in case of necessity, to grant that for meat which is reported for shipment to a public or private warehouse the inspection in whole or in part be postponed until the time of notification of taking the wares out of storage. Permission is to be given only when at the place of the warehouse there is also an inspection office.

§ 19.

If the reexportation of the meat rejected from importation is required by the police authorities, it shall take place under customs seal or custom-house escort. The same obtains for meat voluntarily withdrawn. Meat rejected or voluntarily withdrawn shall be designated as such in the accompanying papers.

§ 20.

When, by order of the police authorities (§ 28 of the regulations D, concerning the carrying out of the law), condemned meat is to be disposed of in such a manner that it can do no harm, a customs or revenue official shall be present if the customs on the meat are to be remitted or reduced because of such disposal. This official shall present to the office a written notice with regard to the manner of disposal of the meat, which [notice] becomes a voucher for the customs registers. The police authorities shall give ample notification to the customs office as to the place and time of such disposal of the meat.

According to specific regulations of the administrative authorities in special cases the cooperative surveillance of such disposal of condemned meat by a customs or revenue official may be omitted. In such a case the police authorities after the accomplishment of such disposal of the meat shall make out a written certificate for the customs office as a voucher for the customs registers.

If the packing material is not burned or otherwise harmlessly disposed of, but has been disinfected (§ 28, paragraph 4, of the regulations D, concerning the carrying out of the law), either duty is to be paid on it according to its nature or it is to be reexported past the customs line.

§ 18.

Nach Beendigung der Untersuchung und Kennzeichnung des Fleisches hat das Amt, an dessen Sitz die Untersuchung erfolgt ist, die weitere zollamtliche Abfertigung vorzunehmen.

Das auf Grund der Untersuchung freigegebene Fleisch kann nunmehr in den freien Verkehr gesetzt, auf Begleitschein I oder II versandt oder zur öffentlichen Niederlage oder zu einem Privatlager abgefertigt werden.

Die Direktivbehörden sind ermächtigt im Bedürfnissfalle zu gestatten, dass für Fleisch, welches zur öffentlichen Niederlage oder zu einem Privatlager abgefertigt werden soll, die Untersuchung ganz oder teilweise bis zu dem Zeitpunkte der Abmeldung von der Niederlage ausgesetzt bleibt. Die Genehmigung ist nur zu erteilen, wenn sich am Orte der Niederlage auch eine Untersuchungsstelle befindet.

§ 19.

Wird die Wiederausfuhr des von der Einfuhr zurückgewiesenen Fleisches von der Polizeibehörde veranlasst, so hat sie unter Zollverschluss oder zollamtlicher Begleitung zu erfolgen. Dasselbe gilt für freiwillig zurückgezogenes Fleisch. Das zurückgewiesene oder freiwillig zurückgezogene Fleisch ist in dem Begleitpapier als solches zu bezeichnen.

§ 20.

Der unschädlichen Beseitigung beanstandeten Fleisches, welche von der Polizeibehörde veranlasst wird (§ 28 der Ausführungsbestimmungen D), hat ein Zoll- oder Steuerbeamter beizuwohnen, sofern dadurch die Zollfreiheit des Fleisches oder eine Zollermässigung herbeigeführt werden soll. Dieser hat über die Art der Beseitigung des Fleisches eine schriftliche Anzeige, welche Belag für die Zollregister wird, der Amtsstelle vorzulegen. Die Polizeibehörde hat der Zollstelle über Ort und Zeit der unschädlichen Beseitigung rechtzeitig Mitteilung zu machen.

Nach näherer Bestimmung der Direktivbehörde kann in besonderen Fällen von der Mitüberwachung der unschädlichen Beseitigung beanstandeten Fleisches durch einen Zoll- oder Steuerbeamten abgesehen werden. Solchenfalls hat die Polizeibehörde nach Ausführung der unschädlichen Beseitigung des Fleisches eine schriftliche Bescheinigung hierüber der Zollstelle als Belag für die Zollregister mitzuteilen.

Ist das Verpackungsmaterial nicht verbrannt oder anderweit unschädlich beseitigt, sondern desinfiziert worden (§ 28 Abs. 4 der Ausführungsbestimmungen D), so ist es entweder nach Massgabe seiner Beschaffenheit zu verzollen oder in das Ausland wieder auszuführen.

§ 21.

To meat which is not intended for food for man, and which according to § 29 of the regulations D, concerning the carrying out of the law is admitted for importation by the police authorities without previous inspection, after proof has been established that it has been made useless as food for man in the prescribed manner, §§ 13 to 20 do not apply; on the contrary, in such cases the usual prescribed dispatching procedure obtains.

The latter obtains also in the case of § 22 of the regulations D, concerning the carrying out of the law.

In making the material unfit for use, § 20 has its corresponding application.

§ 22.

In establishing the quantity of the inspected meat to be treated as subject to customs and the amount of customs to be paid, the process shall be according to the following principles:

(a) For meat which is disposed of in such a manner that it can do no harm (§ 20) and in the process is destroyed, customs is not collected. The same obtains for the samples taken, so far as they have been used for the purposes of inspection or have thereby become unfit for use.

(b) In how far customs are to be collected in the case of § 21, or in case of harmless disposal which does not lead to a destruction of the wares, is to be decided according to the customs law [Vereinszollgesetz], the table of duties and the regulations issued concerning these.

(c) Whether duties are to be collected for wares rejected from importation or voluntarily withdrawn—inclusive of the samples returned to the customs authorities (§ 16, paragraph 2)—is regulated according to the provisions of the customs law [Vereinszollgesetz] and of the permit regulations.

§ 23.

If, in case the wares are intended for shipment in direct transit (§ 11, No. 2), this intention is afterwards changed, then—without prejudice to any punitive proceedings to be undertaken according to § 27, No. 4, of the law—the meat inspection shall immediately follow. The same obtains for such shipments as are imported through unauthorized frontier places otherwise than by post and which are not recognized to be subject to meat inspection until they have reached their place of destination. In both cases the provisions of §§ 13 to 22 have their corresponding application.

§ 24.

Postal shipments with content subject to [meat] inspection are to be marked by the post-office authorities with the designation "Fleisch-

§ 21.

Auf Fleisch, welches nicht für den menschlichen Genuss bestimmt ist und seitens der Polizeibehörde nach § 29 der Ausführungsbestimmungen D ohne vorherige Untersuchung zur Einfuhr zugelassen wird, nachdem seine Unbrauchbarmachung für den menschlichen Genuss in der vorgeschriebenen Weise sichergestellt ist, finden die §§ 13 bis 20 keine Anwendung, vielmehr bewendet es in solchen Fällen bei dem allgemein vorgeschriebenen Abfertigungsverfahren.

Letzteres gilt auch im Falle des § 22 der Ausführungsbestimmungen D.

Auf die Unbrauchbarmachung findet § 20 entsprechende Anwendung.

§ 22.

Bei der Festsetzung der als zollpflichtig zu behandelnden Menge des untersuchten Fleisches und des zu entrichtenden Zollbetrags ist nach folgenden Grundsätzen zu verfahren:

a) Für Fleisch, welches unschädlich beseitigt (§ 20) und dabei vernichtet worden ist, kommt Zoll nicht zur Erhebung. Das gleiche gilt für die entnommenen Proben, soweit sie für die Zwecke der Untersuchung verbraucht worden oder dadurch unbrauchbar geworden sind.

b) Inwieweit im Falle des § 21 oder bei der unschädlichen Beseitigung, die nicht zu einer Vernichtung der Ware führt, Zollerhebung eintritt, ist nach dem Vereinszollgesetze, dem Zolltarif und den dazu ergangenen Bestimmungen zu beurteilen.

c) Ob für die von der Einfuhr zurückgewiesenen oder freiwillig zurückgezogenen Waren—einschliesslich der an die Zollbehörde zurückgelangten Proben (§ 16 Abs. 2)—Zoll zu erheben ist, regelt sich nach den Vorschriften des Vereinszollgesetzes und des Begleitscheinregulativs.

§ 23.

Wird im Falle der Bestimmung der Ware zur unmittelbaren Durchfuhr (§ 11 Ziffer 2) diese Bestimmung nachträglich geändert, so ist—unbeschadet des nach § 27 Ziffer 4 des Gesetzes etwa einzuleitenden Strafverfahrens—die Fleischbeschau alsbald nachzuholen. Dasselbe gilt für solche Sendungen, die über nicht zugelassene Grenzstellen in anderer Weise als mit der Post eingeführt und erst am Bestimmungsort als fleischbeschaupflichtig erkannt werden. In beiden Fällen sind die Vorschriften der §§ 13 bis 22 entsprechend anzuwenden.

§ 24.

Postsendungen mit beschaupflichtigem Inhalte sind von der Postbehörde durch die Bezeichnung "Fleischbeschau" kenntlich zu machen

beschau" ["Meat inspection"] and to be taken to a customs or revenue office at whose place is found a [meat] inspection office competent for the examination. This also obtains when, in the case of a shipment whose content has not been recognized from the beginning as subject to [meat] inspection, at the final clearance such content is found and at the place of the office there is not present an authorized place for the examination. The final clearance, in this case, is to be left to the office at whose place the examination is made, and the postal parcel to be returned to and receipted for by the post-office authorities. Upon the application of the addressee further shipment may be suspended and the wares subject to inspection be destroyed under customs surveillance.

The provisions of § 16 of the postal-duties regulations are not influenced by the above regulations.

§ 25.

§§ 13 to 22 apply to postal trade (§ 24), with the provision that in the case of shipping post packages subject to [meat] inspection to the place of [meat] inspection, as well as of post packages whose content, upon the ground of examination, is rejected from importation or voluntarily withdrawn, the making out of permits, and the placing of a customs seal or custom-house escort is not necessary.

§ 26.

Meat which in accordance with the regulation concerning the treatment by the customs office of wares reimported through a region outside the customs line to a point within the customs line is shipped to a point outside the customs line is to be sent under customs seal or under custom-house escort.

At the office of reimportation the final clearance shall always take place according to § 11 of the regulation mentioned. If no suspicion arises with respect to the identity of the wares presented with the exported wares, §§ 9, paragraph 1, and 13 to 25 do not apply.

§ 27.

In all other respects for the importation of meat the regulations of the customs law [Vereinszollgesetz] and of the provisions issued with regard to the carrying out of the regulations apply.

§ 28.

The specific regulations with regard to the measures to be taken by customs authorities for the entrance and inspection places situated outside the customs line shall be issued by the [separate] federated governments concerned.

und einem Zoll- oder Steueramte zuzuführen, an dessen Sitze sich eine für die Untersuchung zuständige Beschaustelle befindet. Dies gilt auch dann, wenn bei einer Sendung, deren Inhalt als beschaupflichtig nicht von Anfang an erkannt worden ist, bei der Schlussabfertigung ein solcher Inhalt vorgefunden wird und am Sitze des Amtes eine zur Untersuchung befugte Stelle nicht vorhanden ist. Die Schlussabfertigung ist in diesem Falle dem Amte, an dessen Sitze die Untersuchung stattfindet, zu überlassen und das Poststück der Postbehörde gegen Quittung zurückzugeben. Auf Antrag des Empfängers kann von der Weitersendung abgesehen und die beschaupflichtige Ware unter zollamtlicher Aufsicht vernichtet werden.

Die Vorschriften des § 16 des Postzollregulativs werden durch vorstehende Bestimmungen nicht berührt.

§ 25.

Die §§ 13 bis 22 finden auf den Postverkehr (§ 24) mit der Massgabe Anwendung, dass bei der Versendung von beschaupflichtigen Poststücken zur Beschaustelle, sowie von Poststücken, deren Inhalt auf Grund der Untersuchung von der Einfuhr zurückgewiesen oder freiwillig zurückgezogen wird, die Ausstellung von Begleitscheinen und die Anlegung eines Zollverschlusses oder zollamtliche Begleitung nicht erforderlich ist.

§ 26.

Fleisch, welches auf Grund des Regulativs, die zollamtliche Behandlung von Warensendungen aus dem Inlande durch das Ausland nach dem Inlande betreffend, zur Versendung in das Ausland abgefertigt wird, ist unter zollamtlichem Verschluss oder unter zollamtlicher Begleitung abzulassen.

Beim Wiedereingangsamte hat stets die Schlussabfertigung gemäss § 11 des bezeichneten Regulativs einzutreten. Ergeben sich hierbei keine Bedenken hinsichtlich der Identität der vorgeführten mit den ausgeführten Waren, so finden die §§ 9 Absatz 1 und 13 bis 25 keine Anwendung.

§ 27.

Im übrigen finden auf die Einfuhr von Fleisch die Bestimmungen des Vereinszollgesetzes und der dazu erlassenen Ausführungsvorschriften Anwendung.

§ 28.

Die näheren Vorschriften über das Verfahren der Zollbehörden bei den im Auslande gelegenen Einlass- und Untersuchungsstellen werden von den beteiligten Landesregierungen erlassen.

Proclamation.

Concerning the marking of inspected foreign meat, of February 10, 1903.

In accordance with § 26, paragraph 3, of the regulations D concerning the carrying out of the law with regard to the inspection of food animals and of meat, of June 3, 1900 (appendix to No. 22 of the Centralblatt für das Deutsche Reich, Jahrgang 1902, p. 39*), the following regulations are made for the marking of inspected foreign meat:

1. The stamps made use of must present exactly the shape and size given in § 26, paragraph 4, of the regulations D concerning the carrying out of the law—without prejudice to the exceptions allowed in paragraph 5 in the place cited.

2. The inscriptions shall be made in Latin letters and of such a size as to be easily legible.

The letters and the margins must be sharply defined.

3. The inscriptions are without exception to be placed upon straight lines.

4. Every stamp shall be provided with the inscription "Ausland" ["Foreign"] on the uppermost line. In the case of meat found fit, there follows upon another line the symbol of the customs or revenue office at which the inspection is undertaken. As such a symbol, only the name of the inspection office given in column 2 of the following list or the abbreviation added in parentheses is to be used. The addition of the official designation of the inspection office shall be omitted.

5. In the case of stamps for meat of horses or other solipeds, immediately after the word "Ausland" ["Foreign"], upon a special line the word "Pferd" ["Horse"] is inserted.

6. Upon a line preceding the symbol of the customs or revenue office the stamps for condemned meat shall be provided with the [following] inscriptions:

"Zurückgewiesen" ["Rejected"], in the case of rejected meat;

"Zu beseitigen" ["To be disposed of"], in the case of meat to be disposed of in such a manner that it can do no harm;

"Z," in the case of voluntarily withdrawn meat.

7. The placing of other names, designations, or symbols (for example, coat of arms) is to be avoided. An exception is made for the use of Latin or Arabic numerals as differentiating signs for the use of officials inside the office.

8. In case that for several customs or revenue offices a common [meat] inspection office is established, the decision as to the stamp is reserved.

COUNT v. POSADOWSKY,
Deputy Imperial Chancellor.

BERLIN, *February 10, 1903.*

Bekanntmachung,

betreffend die Kennzeichnung des untersuchten ausländischen Fleisches. Vom 10. Februar 1903.

Auf Grund des § 26 Abs. 3 der Ausführungsbestimmungen D zum Schlachtvieh- und Fleischbeschaugesetze vom 3. Juni 1900 (Beilage zu Nr. 22 des Centralblattes für das Deutsche Reich, Jahrgang 1902, Seite 39*) wird für die Kennzeichnung des untersuchten ausländischen Fleisches folgendes bestimmt:

1. Die zur Verwendung gelangenden Stempel müssen genau die im § 26 Abs. 4 der Ausführungsbestimmungen D angegebenen Formen und Grössenverhältnisse—unbeschadet der im Abs. 5 a. a. O. zugelassenen Ausnahmen—aufweisen.

2. Die Inschriften sind mit lateinischen Schriftzeichen herzustellen und in solcher Grösse anzufertigen, dass sie gut leserlich sind.

Die Schriftzeichen und die Ränder müssen scharf ausgeprägt sein.

3. Die Inschriften sind ausnahmslos auf geraden Linien anzubringen.

4. Jeder Stempel hat auf der obersten Zeile die Inschrift "Ausland" zu enthalten. Bei tauglich befundenem Fleische folgt auf neuer Zeile das Zeichen der Zoll- oder Steuerstelle, bei welcher die Untersuchung vorgenommen ist. Als solches Zeichen ist ausschliesslich der in Spalte 2 des nachstehenden Verzeichnisses angegebene Name der Untersuchungsstelle oder die in Klammern beigefügte Kürzung anzuwenden. Die Beifügung der Amtsbezeichnung der Untersuchungsstelle hat zu unterbleiben.

5. Bei den Stempeln für Fleisch von Pferden oder anderen Einhufern wird unmittelbar nach dem Worte "Ausland" auf einer besonderen Zeile das Wort "Pferd" eingeschoben.

6. Die Stempel für beanstandetes Fleisch enthalten auf einer dem Zeichen der Zoll- oder Steuerstelle vorangehenden Zeile die Inschrift

"Zurückgewiesen" bei zurückgewiesenem Fleische,

"Zu beseitigen" bei unschädlich zu beseitigendem Fleische,

"Z" bei freiwillig zurückgezogenem Fleische.

7. Die Anbringung sonstiger Namen, Bezeichnungen oder Zeichen (z. B. Wappen) ist zu vermeiden. Ausgenommen ist die Verwendung von lateinischen oder arabischen Ziffern als Unterscheidungsmerkmale für den inneren dienstlichen Verkehr.

8. Für den Fall, dass für mehrere Zoll- oder Steuerstellen eine gemeinsame Beschaustelle errichtet ist, bleibt die Bestimmung des Stempelzeichens vorbehalten.

Berlin, *den 10. Februar 1903.*

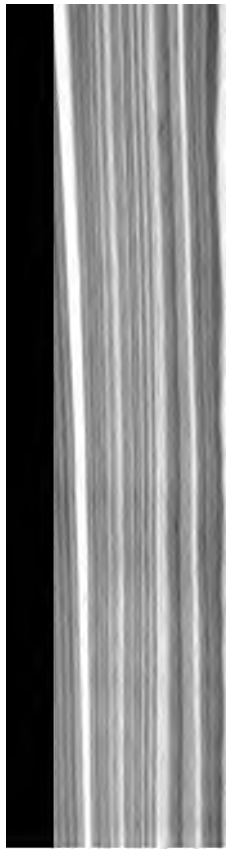
Der Stellvertreter des Reichskanzlers.

Graf v. Posadowsky.

Basel (Baden), customs office at the Baden railway office	Basel B.
Basel (Alsace-Lorraine), branch customs office I	Basel E.
Bentheim, branch customs office I	Bentheim.
Berlin, head revenue office for foreign articles	Berlin.
Beuthen, Upper Silesia clearance office	Beuthen.
Bielefeld, revenue office I at the railway station	Bielefeld (Bi
Bocholt, branch customs office I	Bocholt.
Bodenbach, branch customs office I	Bodenbach (
Borken, branch customs office I	Borken.
Brake, head customs office	Brake.
Braunschweig, head revenue office	Braunschwei
Bremen, head customs office	Bremen.
Bremerhaven, head customs office	Bremerhaver
Breslau, head revenue office I	Breslau.
Bromberg, head revenue office	Bromberg (E
Chemnitz, head customs office	Chemnitz (C
Cleve, head customs office	Cleve.
Cologne, head revenue office for foreign articles	Cologne.
Crefeld, head revenue office	Crefeld (Cre
Dalheim, branch customs office I	Dalheim.
Danzig, head customs office	Danzig.
Darmstadt, head revenue office	Darmstadt (I
Dessau, head revenue office	Dessau.
Deutsch-Avricourt, branch customs office I	Avricourt (A
Diedenhofen, head customs office	Diedenhofen
Dortmund, head revenue office	Dortmund (I
Dresden, head customs office I	Dresden.
Düren, head revenue office	Düren.
Düsseldorf, head revenue office	Düsseldorf (I
Duisburg, head revenue office	Duisburg (D
Eger, branch customs office I	Eger.
Elberfeld, head revenue office	Elberfeld (E
Elten, branch customs office I	Elten.
Emden, head customs office	Emden.
Emmerich, head customs office	Emmerich (I
Erfurt, head revenue office	Erfurt.
Essen, revenue office I at the Cologne-Mindener railway station	Essen.

Verzeichnis der Untersuchungsstellen für ausländisches Fleisch.

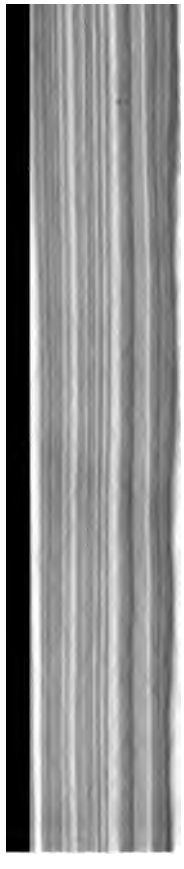
Bezeichnung der Untersuchungsstelle.	Zeichen der Untersuchungsstelle.
1.	2.
Aachen, Hauptzollamt	Aachen.
Altkirch, Hauptzollamt	Altkirch.
Altmünsterol, Nebenzollamt I	Altmünsterol (Altmünstl.).
Altona, Hauptzollamt	Altona.
Augsburg, Hauptzollamt	Augsburg (Augsbg.).
Avricourt s. Deutsch-, Nebenzollamt I	Avricourt (Avric.).
Baden, Hauptsteueramt	Baden.
Basel (Baden), Zollamt am badischen Bahnhofe	Basel B.
Basel (Els.-Lothr.), Nebenzollamt I	Basel E.
Bentheim, Nebenzollamt I	Bentheim.
Berlin, Hauptsteueramt für ausländische Gegenstände.	Berlin.
Beuthen O. Schl., Zollabfertigungsstelle	Beuthen.
Bielefeld, Steueramt I am Bahnhofe	Bielefeld (Bielefd.).
Bocholt, Nebenzollamt I	Bocholt.
Bodenbach, Nebenzollamt I	Bodenbach (Bodenbch.).
Borken, Nebenzollamt I	Borken.
Brake, Hauptzollamt	Brake.
Braunschweig, Hauptsteueramt	Braunschweig (Braunschw.).
Bremen, Hauptzollamt	Bremen.
Bremerhaven, Hauptzollamt	Bremerhaven (Bremerhn.).
Breslau, Hauptsteueramt I	Breslau.
Bromberg, Hauptsteueramt	Bromberg (Brombg.).
Chemnitz, Hauptzollamt	Chemnitz (Chemn.).
Cleve, Hauptzollamt	Cleve.
Cöln, Hauptsteueramt für ausländische Gegenstände.	Cöln.
Crefeld, Hauptsteueramt	Crefeld (Crefd.).
Dalheim, Nebenzollamt I	Dalheim.
Danzig, Hauptzollamt	Danzig.
Darmstadt, Hauptsteueramt	Darmstadt (Darmst.).
Dessau, Hauptsteueramt	Dessau.
Deutsch-Avricourt, Nebenzollamt I	Avricourt (Avric.).
Diedenhofen, Hauptzollamt	Diedenhofen (Diedenh.).
Dortmund, Hauptsteueramt	Dortmund (Dortmd.).
Dresden, Hauptzollamt I	Dresden.
Düren, Hauptsteueramt	Düren.
Düsseldorf, Hauptsteueramt	Düsseldorf (Düsseldf.).
Duisburg, Hauptsteueramt	Duisburg (Duisbg.).
Eger, Nebenzollamt I	Eger.
Elberfeld, Hauptsteueramt	Elberfeld (Elberfd.).
Elten, Nebenzollamt I	Elten.
Emden, Hauptzollamt	Emden.
Emmerich, Hauptzollamt	Emmerich (Emmer.)
Erfurt, Hauptsteueramt	Erfurt.
Essen, Steueramt I am Cöln-Mindener Bahnhofe	Essen.
Eydtkuhnen, Hauptzollamt	Eydtkuhnen (Eydtk.).
Fentsch, Nebenzollamt I	Fentsch.
Flensburg, Hauptzollamt	Flensburg (Flensbg.)
Frankfurt a. M., Hauptsteueramt	Frankfurt a. M. (Frankf.)
Freiburg, Hauptsteueramt	Freiburg (Freibg.).
Friedrichshafen, Hauptzollamt	Friedrichshafen (Friedrhn.).
Fürth, Hauptzollamt	Fürth.
Furth a. W., Hauptzollamt	Furth a. W. (Furth W.)
Geestemünde, Hauptzollamt	Geestemünde (Geestem.).
Gera, Hauptsteueramt	Gera.
Glauchau, Steueramt	Glauchau.
Glogau, Hauptsteueramt	Glogau.



Hamburg, Meyerstrasse, head customs office	Hamburg M.
Hamburg, St. Annen, head customs office	Hamburg A.
Heidelberg, head revenue office	Heidelberg (
Heilbronn, head customs office	Heilbronn (
Hof, head customs office	Hof.
Horbach, branch customs office II	Horbach.
St. Johann-Saarbrücken, head revenue office	Saarbrücken
Kaiserslautern, head customs office	Kaiserslaute
Kaldenkirchen, head customs office	Kaldenkirch
Karlsruhe, head revenue office	Karlsruhe (
Kattowitz, branch customs office I	Kattowitz (
Kiel, head customs office	Kiel.
Königsberg, head revenue office	Königsberg (
Konstanz, head revenue office	Konstanz.
Kufstein, branch customs office I	Kufstein.
Lahr, head revenue office	Lahr.
Landau in Pfalz, head customs office	Landau i. Pf
Landshut, head customs office	Landshut.
Leipzig, head customs office I	Leipzig.
Lindau, head customs office	Lindau.
Lippstadt, head revenue office	Lippstadt (L
Lörrach, head revenue office	Lörrach.
Ludwigshafen on the Rhine, head customs office	Ludwigshafe wigshn.).
Lübeck, head customs office	Lübeck.
Magdeburg, head revenue office I	Magdeburg (
Mayence, head revenue office	Mainz.
Mannheim, head customs office	Mannheim (
Memel, head customs office	Memel.
Metz, head customs office	Metz.
Mülhausen, head revenue office	Mülhausen (
Munich I, head customs office	München I.
Munich II, head customs office	München II.
Münster, head revenue office	Münster.
Myslowitz, head customs office	Myslowitz (
Neumünster, revenue office I	Neumünster
Novéant, branch customs office I	Novéant.
Nuremberg, head customs office	Nürnberg (N
Oderberg, Austria, branch customs office I	Oderberg, Ös
Offenbach, head revenue office	Offenbach (C

Verzeichnis der Untersuchungsstellen für ausländisches Fleisch—Fortsetzung folgt.

Bezeichnung der Untersuchungsstelle.	Zeichen der Untersuchungsstelle.
1.	2.
Goch, Nebenzollamt I	Goch.
Greiz, Steueramt	Greiz.
Halle a. S., Hauptsteueramt	Halle a. S. (Halle S.).
Hamburg, Entenwärder, Hauptzollamt	Hamburg E. (Hambg.).
Hamburg, Erikus, Hauptzollamt	Hamburg Er. (Hambg. Er.).
Hamburg, Jonas, Hauptzollamt	Hamburg J. (Hambg. J.).
Hamburg, Kehrwieder, Hauptzollamt	Hamburg K. (Hambg. K.).
Hamburg, Meyerstrasse, Hauptzollamt	Hamburg M. (Hambg. M.).
Hamburg, St. Annen, Hauptzollamt	Hamburg A. (Hambg. A.).
Heidelberg, Hauptsteueramt	Heidelberg (Heidelbg.).
Heilbronn, Hauptzollamt	Heilbronn (Heilbr.).
Hof, Hauptzollamt	Hof.
Horbach, Nebenzollamt II	Horbach.
St. Johann-Saarbrücken, Hauptsteueramt	Saarbrücken (Saarbr.).
Kaiserslautern, Hauptzollamt	Kaiserslautern (Kaisersl.).
Kaldenkirchen, Hauptzollamt	Kaldenkirchen (Kaldenk.).
Karlsruhe, Hauptsteueramt	Karlsruhe (Karlsr.).
Kattowitz, Nebenzollamt I	Kattowitz (Kattow.).
Kiel, Hauptzollamt	Kiel.
Königsberg, Hauptsteueramt	Königsberg (Königsbg.).
Konstanz, Hauptsteueramt	Konstanz.
Kufstein, Nebenzollamt I	Kufstein.
Lahr, Hauptsteueramt	Lahr.
Landau i. Pfalz, Hauptzollamt	Landau i. Pfalz (Landau).
Landshut, Hauptzollamt	Landshut.
Leipzig, Hauptzollamt I	Leipzig.
Lindau, Hauptzollamt	Lindau.
Lippstadt, Hauptsteueramt	Lippstadt (Lippstdt.).
Lörrach, Hauptsteueramt	Lörrach.
Ludwigshafen a. Rh., Hauptzollamt	Ludwigshafen a. Rh. (Ludwigshn.).
Lubeck, Hauptzollamt	Lübeck.
Magdeburg, Hauptsteueramt I	Magdeburg (Magdebg.).
Mainz, Hauptsteueramt	Mainz.
Mannheim, Hauptzollamt	Mannheim (Mannh.).
Memel, Hauptzollamt	Memel.
Metz, Hauptzollamt	Metz.
Mülhausen, Hauptsteueramt	Mülhausen (Mülhsn.).
München I, Hauptzollamt	München I.
München II, Hauptzollamt	München II.
Münster, Hauptsteueramt	Münster.
Myslowitz, Hauptzollamt	Myslowitz (Myslow.).
Neumünster, Steueramt I	Neumünster (Neumünst.).
Novéant, Nebenzollamt I	Novéant.
Nürnberg, Hauptzollamt	Nürnberg (Nürnbg.).
Oderberg, Österr.-, Nebenzollamt I	Oderberg, Österr. (Oderbg.).
Offenbach, Hauptsteueramt	Offenbach (Offenbch.).
Oldenburg, Hauptsteueramt	Oldenburg (Oldenbg.).
Passau, Hauptzollamt	Passau.
Plauen i. V., Hauptzollamt	Plauen i. V. (Plauen).
Posen, Hauptsteueramt	Posen.
Regensburg, Hauptzollamt	Regensburg (Regensbg.).
Rendsburg, Steueramt I	Rendsburg (Rendsbg.).
Riesa, Zollabfertigungsstelle am Hafen	Riesa.
Rosenheim, Hauptzollamt	Rosenheim (Rosenh.).
Rostock, Hauptzollamt	Rostock.
Ruhrort, Steueramt I	Ruhrort.
Saarbrücken (St. Johann-), Hauptsteueramt	Saarbrücken (Saarbr.).
Säckingen, Hauptsteueramt	Säckingen (Säcking.).
St. Johann-Saarbrücken, Hauptsteueramt	Saarbrücken (Saarbr.).



[illegible], branch customs office I	[illegible]
Tetschen, branch customs office I	Tetschen.
Thorn, head customs office	Thorn.
Tilsit, head customs office	Tilsit.
Trier, head revenue office	Trier.
Ulm, head customs office	Ulm.
Warnemünde, branch customs office I	Warnemünde (W
Warnsdorf, branch customs office I	Warnsdorf (War
Weener, branch customs office I	Weener.
Woyens, branch customs office I	Woyens.
Würzburg, head customs office	Würzburg (Wür
Zittau, head customs office	Zittau.
Zwickau, head customs office	Zwickau.

Proclamation,

Concerning the completion of [addition to] the list of importation and inspectior imported past the customs line. Of June 24, 1903.

In accordance with § 13, paragraph 2, of the law con inspection of food animals and of meat of June 3, 19 Gesetzbl 547), the Bundesrath has resolved that to the list o tation and inspection places for meat imported past the c (Appendix F to the proclamation of May 30, 1902—Centr plement to No. 22) there should be added under the serial n as an importation and inspection place for fresh meat:

Säckingen, branch customs office II at the Rhine Bridge.

THE IMPERIAL CHANCEI
COUNT v. POSADOWSKY

BERLIN, *June 24, 1903.*

Verzeichnis der Untersuchungsstellen für ausländisches Fleisch—Fortsetzung folgt.

Bezeichnung der Untersuchungsstelle.	Zeichen der Untersuchungsstelle.
1.	2.
Salzburg, Nebenzollamt I	Salzburg (Salzbg.).
Simbach, Hauptzollamt	Simbach.
Singen, Hauptsteueramt	Singen.
Stettin, Hauptsteueramt I	Stettin.
Stralsund, Hauptzollamt	Stralsund (Strals.).
Strassburg, Hauptsteueramt	Strassburg (Strassbg.).
Stuttgart, Hauptzollamt	Stuttgart.
Suderwick, Nebenzollamt I	Suderwick (Suderw.).
Tetschen, Nebenzollamt I	Tetschen.
Thorn, Hauptzollamt	Thorn.
Tilsit, Hauptzollamt	Tilsit.
Trier, Hauptsteueramt	Trier.
Ulm, Hauptzollamt	Ulm.
Warnemünde, Nebenzollamt I	Warnemünde (Warnem.).
Warnsdorf, Nebenzollamt I	Warnsdorf (Warnsdf.).
Weener, Nebenzollamt I	Weener.
Woyens, Nebenzollamt I	Woyens.
Würzburg, Hauptzollamt	Würzburg (Würzbg.).
Zittau, Hauptzollamt	Zittau.
Zwickau, Hauptzollamt	Zwickau.

Bekanntmachung,

betreffend die Ergänzung des Verzeichnisses der Einlass- und Untersuchungsstellen für das in das Zollinland eingehende Fleisch. Vom 24. Juni 1903.

Auf Grund des § 13 Abs. 2 des Gesetzes, betreffend die Schlachtvieh- und Fleischbeschau, vom 3. Juni 1900 (Reichs-Gesetzbl. S. 547) hat der Bundesrat beschlossen, dass in dem Verzeichnisse der Einlass- und Untersuchungsstellen für das in das Zollinland eingehende Fleisch (Anlage F zur Bekanntmachung vom 30. Mai 1902—Centralblatt, Beilage zu Nr. 22—) unter Lfd. Nr. 114a als Einlass- und Untersuchungsstelle für frisches Fleisch hinzutritt:

Säckingen. Nebenzollamt II an der Rheinbrücke.

Berlin, *den 24. Juni 1903.*

Der Reichskanzler.
In Vertretung: Graf v. Posadowsky.

Proclamation,

Concerning the stamp symbols of later designated inspection places for foreign meat. Of June 24, 1903.

In accordance with § 26, paragraph 3, of the regulations D with regard to the carrying out of the law concerning the inspection of food animals and of meat, of June 3, 1900, in addition to the proclamation concerning the marking of the inspected foreign meat, of February 10, 1903 (Centralblatt, p. 46), it is determined that as a stamp symbol, according to No. 4 of this proclamation, the following symbol should be exclusively used by the inspection office: "Säckingen, branch customs office II at the Rhine Bridge."

Säckingen, No. II.

THE IMPERIAL CHANCELLOR.
COUNT V. POSADOWSKY, *Acting.*

BERLIN, *June 24, 1903.*

Concerning the carrying out of the meat-inspection law.

To obviate differences which have occurred in the carrying out of the meat-inspection law with reference to the importation and examination of foreign meat, the ministers of ecclesiastical affairs etc., of agriculture etc., of finance and of commerce and industries, after agreement with the Imperial Chancellor have ordered the following:

1) Fresh blood of animals is considered according to § 1 B. B. D. as meat in the sense of § 4 of the meat-inspection law and consequently according to § 12, paragraph 2, No. 1, R.-G. can be imported past the customs line only "in entire carcasses." Whether *salted* blood can be considered as prepared meat in the sense of § 12, paragraph 2, No. 2, R.-G. is doubtful. The weight of opinion of experts however is in favor of the view that also strongly salted blood has not essentially lost the properties of fresh blood, and for this reason is subject to the principles for the importation of fresh meat. However even if salted blood is considered like prepared meat the inadmissibility of importation results from the fact that the reliable establishing of harmlessness to human health required according to § 12, paragraph 2, No. 2, R.-G. is impossible in the case of blood imported not in connection with entire carcasses. An examination of blood is indeed theoretically conceivable but impracticable. Further, also strong salting is not suited to taking from the blood of diseased animals the danger to human health. Upon [for] these grounds [reasons] salted blood—aside from the case in § 17, R.-G. (compare also § 29 B. B. D.)—can not be admitted to importation.

Advantage is taken of this opportunity to call attention to the fact that not only blood but also all other parts of warm-blooded animals so far as [when] they are suited as food for man are capable of importation in a fresh condition in so far as [when] they are found in natural con-

Bekanntmachung,

betreffend die Stempelzeichen nachträglich zugelassener Untersuchungsstellen für ausländisches Fleisch. Vom 24. Juni 1903.

Auf Grund des § 26 Abs. 3 der Ausführungsbestimmungen D zum Schlachtvieh- und Fleischbeschaugesetze vom 3. Juni 1900 wird im Anschluss an die Bekanntmachung, betreffend die Kennzeichnung des untersuchten ausländischen Fleisches, vom 10. Februar 1903 (Centralblatt S. 46) bestimmt, dass als Stempelzeichen gemäss Nr. 4 dieser Bekanntmachung von der Untersuchungsstelle "Säckingen, Nebenzollamt II an der Rheinbrücke" ausschliesslich anzuwenden ist die Bezeichnung:

Säckingen, Nz. II.

Berlin, *den 24. Juni 1903.*

Der Reichskanzler.
In Vertretung: Graf v. Posadowsky.

Zur Ausführung des Fleischbeschaugesetzes.

Zur Beseitigung von Verschiedenheiten, die bei der Durchführung des Fleischbeschaugesetzes in Bezug auf die Einfuhr und Untersuchung ausländischen Fleisches hervorgetreten sind, haben die Minister der geistlichen etc. Angelegenheiten, für Landwirtschaft etc., der Finanzen und für Handel und Gewerbe im Einverständnisse mit dem Reichskanzler folgendes angeordnet:

1) Frisches Blut von Tieren gilt nach § 1 B. B. D. als Fleisch im Sinne des § 4 des Fleischbeschaugesetzes und kann demzufolge nach § 12 Abs. 2 Nr. 1 R.-G. nur in "ganzen Tierkörpern" in das Zollinland eingeführt werden. Ob *gesalzenes* Blut als zubereitetes Fleisch im Sinne des § 12 Abs. 2 Nr. 2 R.-G. angesehen werden kann, ist zweifelhaft. Die überwiegende Ansicht der Sachverständigen geht indes dahin, dass auch stark gesalzenes Blut die Eigenschaften des frischen Blutes im wesentlichen nicht verloren hat und deshalb den Grundsätzen für die Einfuhr frischen Fleisches unterliegt. Selbst wenn jedoch gesalzenes Blut dem zubereiteten Fleische gleich geachtet wird, ergibt sich die Unzulässigkeit der Einfuhr daraus, dass die nach § 12 Abs. 2 Ziffer 2 R.-G. erforderte zuverlässige Feststellung der Unschädlichkeit für die menschliche Gesundheit bei dem nicht in Verbindung mit ganzen Tierkörpern eingeführten Blut unmöglich ist. Eine Untersuchung von Blut ist zwar theoretisch denkbar, aber praktisch undurchführbar. Auch starkes Salzen ist ferner nicht geeignet, dem Blute von kranken Tieren die Gefährlichkeit für die menschliche Gesundheit zu nehmen. Aus diesen Gründen kann gesalzenes Blut— abgesehen von dem Falle des § 17 R.-G. (vergl. auch § 29 B. B. D.)— zur Einfuhr nicht zugelassen werden.

Bei dieser Gelegenheit wird darauf hingewiesen, dass nicht nur Blut, sondern auch alle anderen Teile von warmblütigen Tieren, sofern sie sich zum Genusse für Menschen eignen, in frischem Zustande nur

nection with the entire carcass or the h
especially also to such internal organs wh
tion [with the entire carcass or half-carcass
by a provision in § 6 B. B. D. Hence, for
casings which are not connected with a c
to importation, and indeed not even whe
place of examination at the same time a
they are alleged to have come.

2) The importation of livers that have
cially of swine's livers has heretofore bee
through a number of examination places
attain the minimum weight of 4 kg. pres
§ 12, paragraph 2, No. 2, R.-G. The con
with regard to the minimum weight shall
not also to cooked meat must, according to
of the origin of the regulation cited, be co
theless the admission of cooked livers to i
consistent with the meat-inspection law.
graph 2, No. 2, R.-G. prepared meat ma
according to the manner in which it has b
dangers to human health are excluded acc
harmlessness to human health can upon im
a reliable way. Neither the one nor th
livers. For, even the cooking of the live
and vegetable disease germs harmless; di
removed from the livers by cooking, thus
disease however thoroughly cooked throug
highly spoiled, nauseous food stuff.

On the other hand the cooking of live
other process of preparation to conceal a
organ; especially fresh tubercular infiltrati
stage of development, and cisticerci, etc.
ner through cooking that either they are n
become indistinct in such a manner as to re
difficult.

For these and other reasons a reliable e
is impracticable.

3) As internal organs, especially of swi
do not attain the weight of 4 kg., in sev
importation of such organs in connection
various other parts of the animal in a *pickl*
For example parts of the head (tongue etc.
in connection with the lung, liver, hear
comply with the provision with regard t
§ 12, paragraph 2, No. 2, R.-G.

insoweit einfuhrfähig sind, als sie sich in natürlichem Zusammenhang mit dem ganzen Tierkörper oder den Tierhälften befinden. Dies gilt insbesondere auch für solche inneren Organe, deren Miteinführung im § 6 B. B. D. nicht zwingend vorgeschrieben ist. Beispielsweise dürfen also frisches Fett oder frische Därme, die sich ausser Zusammenhang mit einem Tierkörper befinden, zur Einfuhr nicht zugelassen werden, und zwar auch dann nicht, wenn sie zugleich mit den Tierkörpern, von denen sie angeblich herrühren, der Untersuchungsstelle zugeführt werden.

2) Die Einfuhr durchgekochter Lebern, insbesondere von Schweinslebern, ist bisher über eine Reihe von Untersuchungsstellen zugelassen worden, selbst wenn sie das für Pökelfleisch in § 12 Abs. 2 Nr. 2 R.-G. vorgeschriebene Mindestgewicht von 4 kg nicht erreichten. Die Auffassung, dass diese Mindestgewichtvorschrift lediglich auf gepökeltes und nicht auch auf gekochtes Fleisch Anwendung zu finden hat, muss nach dem Wortlaute und der Entstehungsgeschichte der angeführten Bestimmung als zutreffend angesehen werden. Gleichwohl erscheint die Zulassung gekochter Lebern zur Einfuhr mit dem Fleischbeschaugesetze nicht vereinbar. Nach § 12 Abs. 2 Nr. 2 R.-G. darf zubereitetes Fleisch nur eingeführt werden, wenn nach der Art seiner Gewinnung und Zubereitung Gefahren für die menschliche Gesundheit erfahrungsgemäss ausgeschlossen sind *oder* die Unschädlichkeit für die menschliche Gesundheit sich in zuverlässiger Weise bei der Einfuhr feststellen lässt. Weder das eine noch das andere trifft für gekochte Lebern zu. Denn auch das Kochen der Lebern vermag nicht alle tierischen oder pflanzlichen Krankheitskeime unschädlich zu machen; krankhafte Einlagerungen werden durch das Kochen aus den Lebern nicht entfernt, krankhaft veränderte Lebern behalten also auch bei noch so gründlicher Durchkochung die Eigenschaften eines hochgradig verdorbenen, ekelerregenden Nahrungsmittels bei.

Andererseits ist das Kochen der Lebern mehr als jedes sonstige Zubereitungsverfahren geeignet, eine krankhafte Beschaffenheit dieses Organs zu verdecken; vor allem werden frische tuberkulöse Einlagerungen, in früher Entwickelung befindliche Echinokokken und Cisticerken etc. durch das Kochen derart verändert, dass sie entweder überhaupt nicht zu erkennen sind oder in einer die Untersuchung erschwerenden Weise undeutlich werden.

Aus diesen und anderen Gründen ist eine zuverlässige Untersuchung gekochter Lebern unausführbar.

3) Da innere Organe, namentlich vom Schwein, einzeln meist nicht das Gewicht von 4 kg erreichen, hat sich an mehreren Untersuchungsstellen eine Einfuhr solcher Organe im Zusammenhang miteinander und mit verschiedenen sonstigen Tierteilen in *gepökeltem* Zustande entwickelt. Beispielsweise werden Kopfteile (Zunge etc.) des Schweins in Verbindung mit Lunge, Leber, Herz etc. eingeführt, um dadurch der Mindestgewichtvorschrift in §12 Abs. 2 Nr. 2 R.-G. zu genügen.

So far as [when] the connected parts actually weigh together at least 4 kg. and further it is established through the test prescribed in § 13 B. B. D a. that the organs etc. have lost the properties of fresh meat even in the inner layers, there is nothing standing in the way of the admission of portions of meat, connected in such a way, to further examination and in case of a favorable result of the latter, to importation.

4) The ordering of foreign prepared fat frequently takes place upon test. Hence not infrequently there are imported past the customs line fat samples in small single shipments of inconsiderable weight. By an examination—of such fat shipments—corresponding exactly to the regulations of the Bundesrath concerning the carrying out [of the law] usually the greater part of the fat content would be used up, besides, the expense of such an examination would be out of all proportion to the value, finally an examination in all cases and to a full compass does not appear necessary upon the ground of health, because as a rule the samples are not used as food for man. Hence the chemical examination of shipments of fat samples up to the weight of about 1 kg. can usually be omitted and is to be restricted to such cases in which the condition of the samples gives rise to special suspicion at the preliminary test, however without a rejection of the fat being pronounced [already] upon the ground of this preliminary test (compare § 21, paragraph under I B. B. D.).

5) According to § 1, paragraph 2 B. B. D. meat peptones until further notice are not considered as meat, hence also are not subject to the regulations of the meat-inspection law and can indiscriminately be admitted to importation.

In § 3, paragraph 7 B. B. D., among those preparations of meat which are to be considered as sausages or other mixtures of chopped meat and therefore according to § 12, paragraph 1, R.-G. are excluded from importation "powdered meat and meat meal (meat meal food excepted) with or without admixtures" are mentioned.

Meat peptones are now imported from abroad partly in a liquid or lard-like condition, partly in a powdered condition, in the latter [condition] to be used especially for the purpose of preparing nutritive media for scientific experiments with disease germs etc. In view of the regulation mentioned in § 3, paragraph 4, B. B. D. doubts have arisen as to whether peptones resembling meat meal can be admitted to importation. Until further notice meat peptones intended for the preparation of nutritive media even when they have the outward appearance of powdered meat are not to be considered as meat in the sense of the meat-inspection law and are to be admitted to importation without examination.

6) It has been established that there was present in imported meat boracic acid, concerning which according to the circumstances of the

Sofern die zusammenhängenden Teile tatsächlich zusammen mindestens 4 kg schwer sind und ferner durch in § 13 B. B. D. a. vorgeschriebene Prüfung festgestellt wird, dass die Organe etc. auch in den inneren Schichten die Eigenschaften frischen Fleisches verloren haben, steht der Zulassung derartig miteinander verbundener Fleischteile zur weiteren Untersuchung und bei günstigem Ausfalle der letzteren zur Einfuhr nichts entgegen.

4) Die Bestellung ausländischen zubereiteten Fettes erfolgt häufig nach Probe. Es gehen daher nicht selten in das Zollinland Fettproben in kleinen Einzelsendungen von unbedeutendem Gewicht ein. Durch eine den Ausführungsbestimmungen des Bundesrats genau entsprechende Untersuchung derartiger Fettsendungen würde gewöhnlich der grössere Teil des Fettinhaltes verbraucht werden, die Kosten einer solchen Untersuchung würden auch in keinem Verhältnisse zu dem Werte stehen, endlich erscheint eine Untersuchung in allen Fällen und in vollem Umfang aus gesundheitlichen Gründen nicht erforderlich, weil die Proben regelmässig nicht zum Genusse für Menschen verwendet werden. Die chemische Untersuchung von Fettprobensendungen bis zum Gewichte von etwa 1 kg kann daher für gewöhnlich unterbleiben und ist auf solche Fälle zu beschränken, in denen die Beschaffenheit der Proben bei der Vorprüfung zu besonderem Verdacht Anlass gibt, ohne dass doch bereits auf Grund dieser Vorprüfung eine Zurückweisung des Fetts ausgesprochen wird (vergl. § 21 Abs. unter I B. B. D.).

5) Nach § 1 Abs. 2 B. B. D. gelten Fleischpeptone bis auf weiteres nicht als Fleisch, unterliegen daher auch nicht den Bestimmungen des Fleischbeschaugesetzes und können ohne Unterschied zur Einfuhr zugelassen werden.

In § 3 Abs. 7 B. B. D. sind unter denjenigen Erzeugnissen aus Fleisch, die als Würste oder sonstige Gemenge aus zerkleinertem Fleisch anzusehen und deshalb nach § 12 Abs. 1 R.-G. von der Einfuhr ausgeschlossen sind, "Fleischpulver und Fleischmehl (ausgenommen Fleischfuttermehl) mit oder ohne Zusätze" aufgeführt.

Fleischpeptone werden nun aus dem Auslande teils in flüssigem oder schmalzartigem, teils in gepulvertem Zustande eingeführt, in letzterem namentlich zu dem Zweck, um zur Herstellung von Nährböden für wissenschaftliche Versuche mit Krankheitserregern etc. verwendet zu werden. Im Hinblick auf die erwähnte Bestimmung im § 3 Abs. 4 B. B. D. sind Zweifel darüber entstanden, ob fleischmehlartige Peptone zur Einfuhr zugelassen werden können. Bis auf weiteres sind zur Herstellung von Nährböden bestimmte Fleischpeptone, auch wenn sie sich äusserlich als Fleischpulver darstellen, als Fleisch im Sinne des Fleischbeschaugesetzes nicht anzusehen und ohne Untersuchung zur Einfuhr zuzulassen.

6) Es ist festgestellt worden, dass in eingeführtem Fleische Borsäure vorhanden war, von der nach Lage der Sache angenommen

case the assumption could be made that it had not been added intentionally to the meat for preservation but had found its way into the meat merely accidentally, for example, from the packing material which formerly was used for the shipment of wares containing boracic acid.

In view of the fact that according to the purpose of § 21, R.-G. and of the regulations issued by the Bundesrath concerning the carrying out [of the law] the importation of meat containing boracic acid is to be considered as absolutely prohibited, such meat can not be admitted to importation, on the contrary is to be rejected from importation.

werden konnte, dass sie nicht absichtlich zur Haltbarmachung dem Fleische zugesetzt worden, sondern nur zufällig, z. B. aus dem Verpackungsmaterial, das früher zum Versand borsäurehaltiger Waren benutzt worden war, in das Fleisch übergegangen war.

Im Hinblick darauf, dass nach der Absicht des § 21 R.-G. und der dazu vom Bundesrat erlassenen Ausführungsbestimmungen die Einfuhr von borsäurehaltigem Fleische schlechthin als verboten zu erachten ist, kann derartiges Fleisch nicht zur Einfuhr zugelassen werden, ist vielmehr von der Einfuhr zurückzuweisen.

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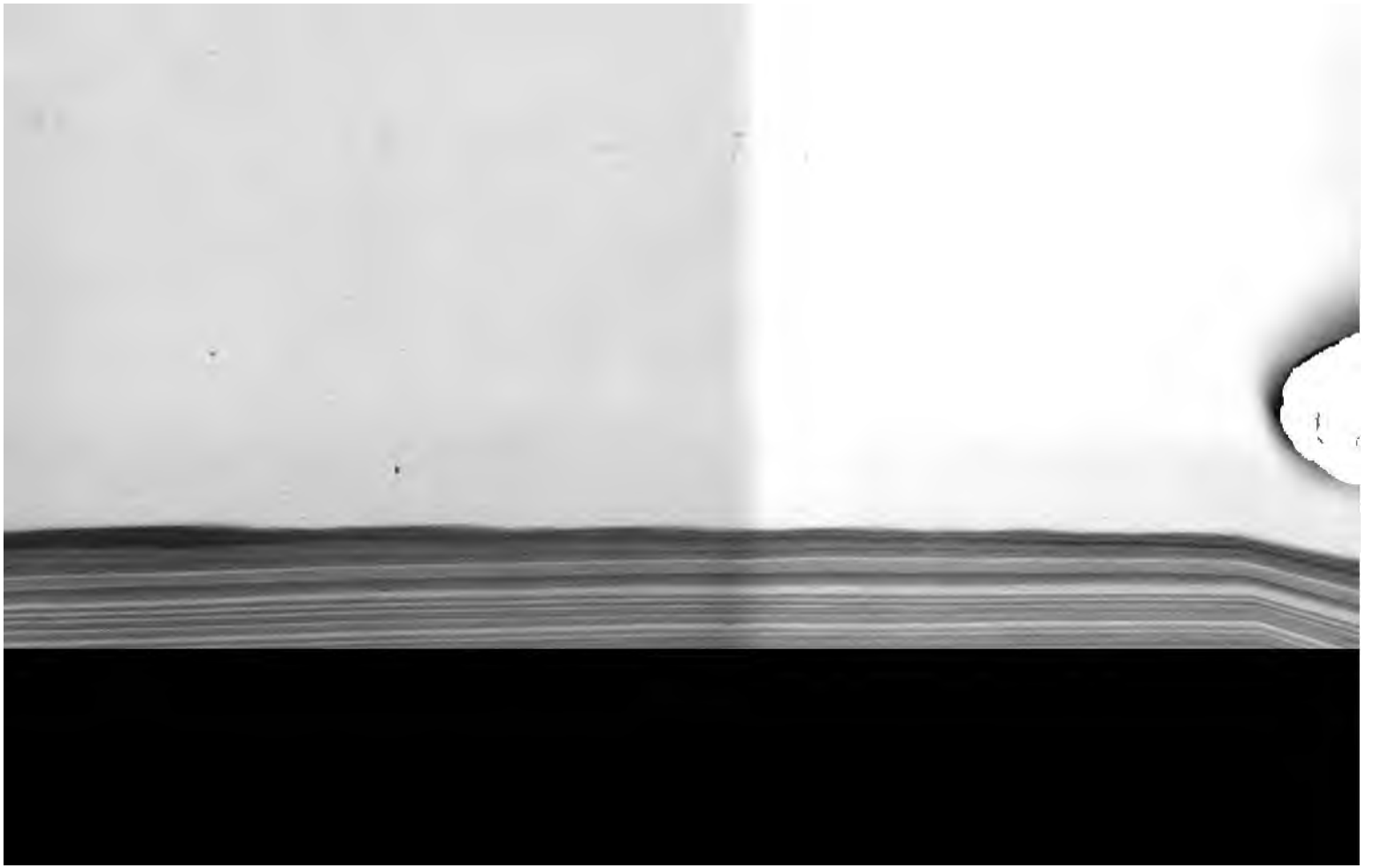

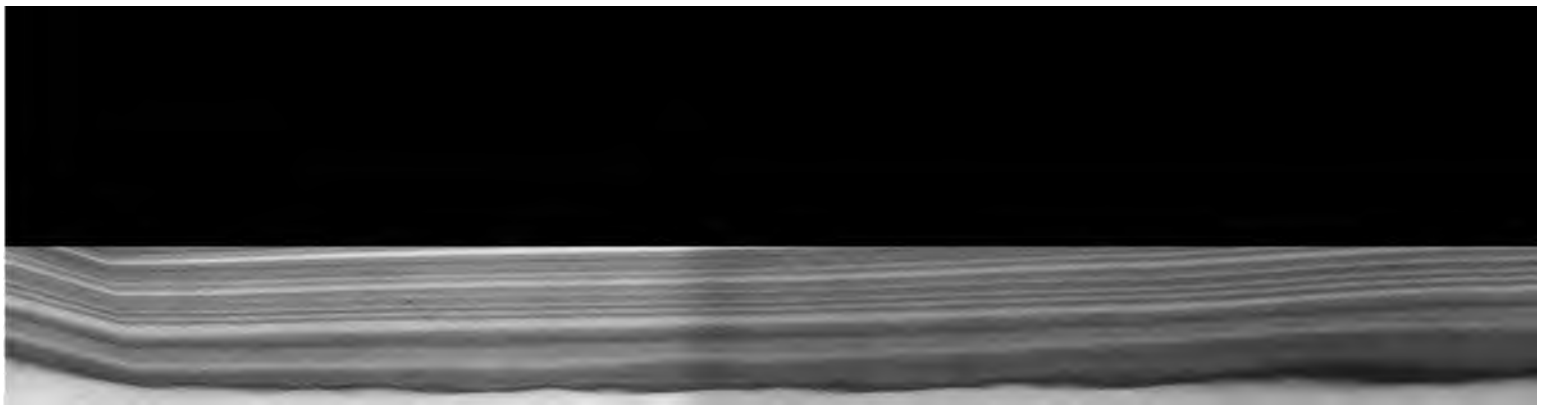

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